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Development of a Rotorcraft/Propulsion Dynamics Interface Analysis: Volume II

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Development of a Rotorcraft/Propulsion Dynamics Interface Analysis: Volume II

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Ames Research Center
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National Aeronautics and
Space Administration

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I. INTRODUCTION

This volume contains user notes on the GENHEL [1, 2] simulation and its modifications. The user documentation was gathered during the course of the present contract.

Figure 1 shows a stuctural chart of the GENHEL program. Additions have been made for the modifications performed under the current contract. The chart lists the subroutine names, and in some cases gives a brief description of the purpose of a subroutine. The lines connecting the subroutines indicate possible calling sequences.

Figure 2 is a listing of the job control language for a sample run of GENHEL on the CDC-7600 computer at the computer center at NASA-Ames. The run shown performs the following steps:

(1) mounts the disk and attaches the various tables, subroutines and libraries associated with the program;

(2) performs a 100 step IC run;

(3) modifies some of the elements of the user accessable common blocks;

(4) trims the simulation, allowing up to 1000 iterations if required;

(5) modifies some more of the elements of the user accessable common blocks;

(6) performs a dynamic check run which integrates the equations for the desired length of time; and

(7) prints out the results.

Figure 3 lists the matrices of coefficients for the perturbational fuselage aerodynamics model. The equations for this model are shown in Figure 5.3 of Volume I. Figure 4 lists similar matrices of coefficients for the perturbational rotor aerodynamics model described in Figure 5.2 of Volume I.

Tables 1 through 6 list the contents of the six user-accessable common blocks used in the program. The blocks include a total of 1112 elements. These common blocks contain the rotorcraft parameters and simulation run control codes. The common blocks are also used to store the responses at each time step. The user can control the simulation by changing elements in the common blocks.

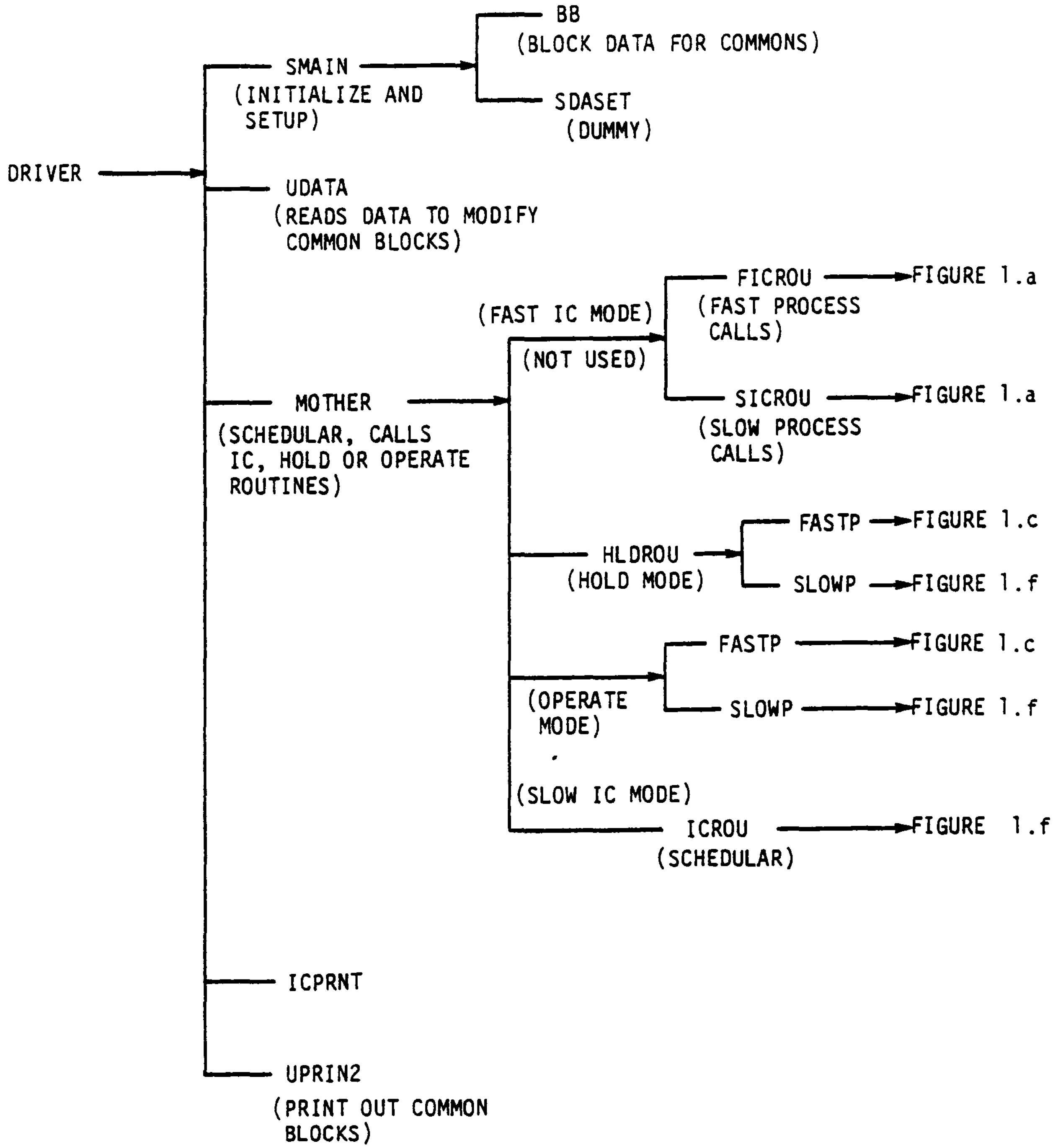


Figure 1 Structural Chart of the GENHEL Program With Modifications

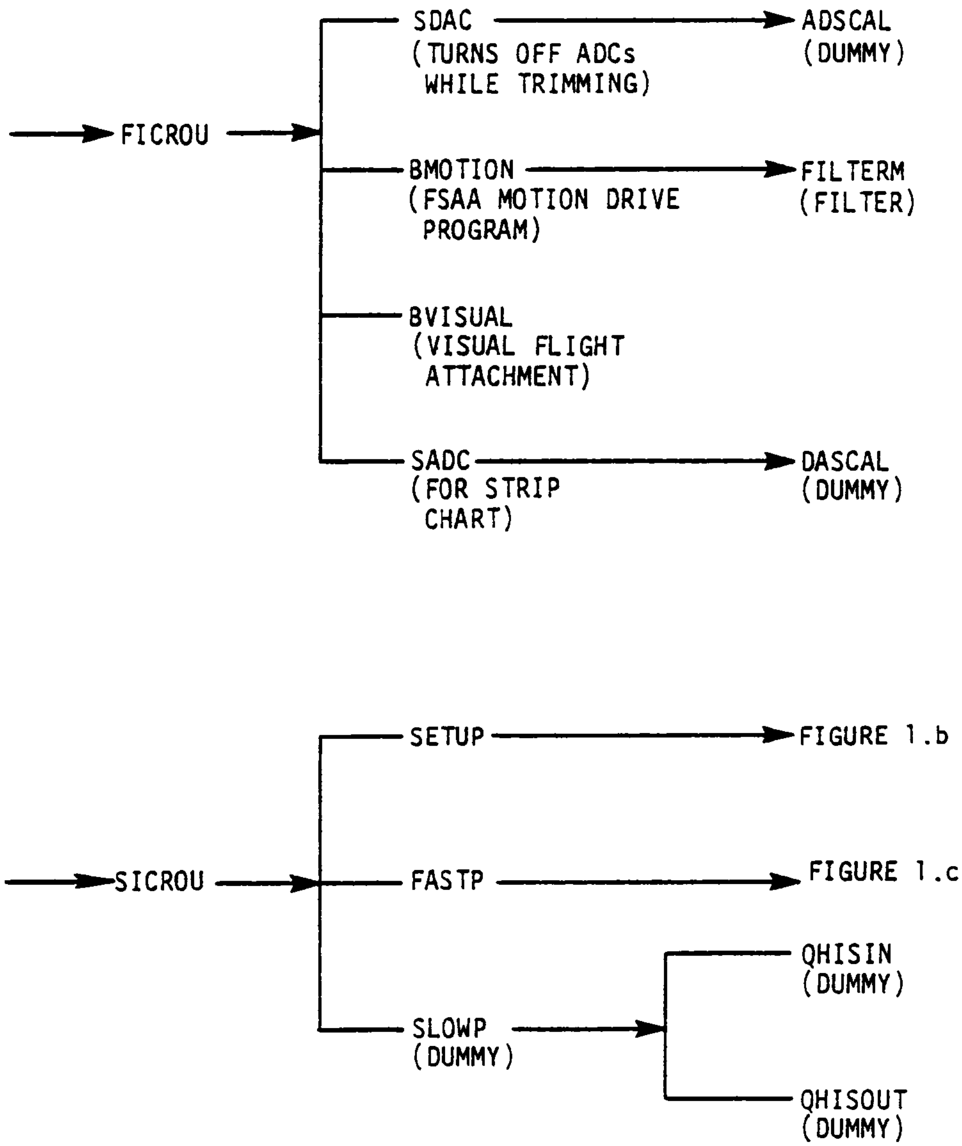


Figure 1a FICROU and SICROU

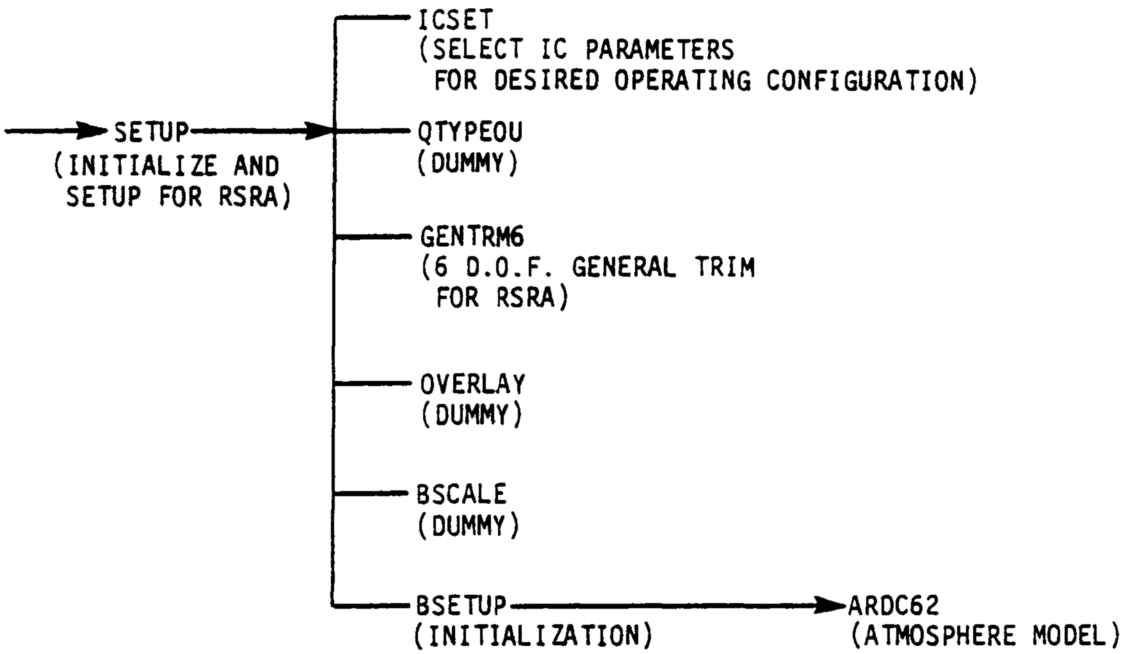


Figure 1b SETUP

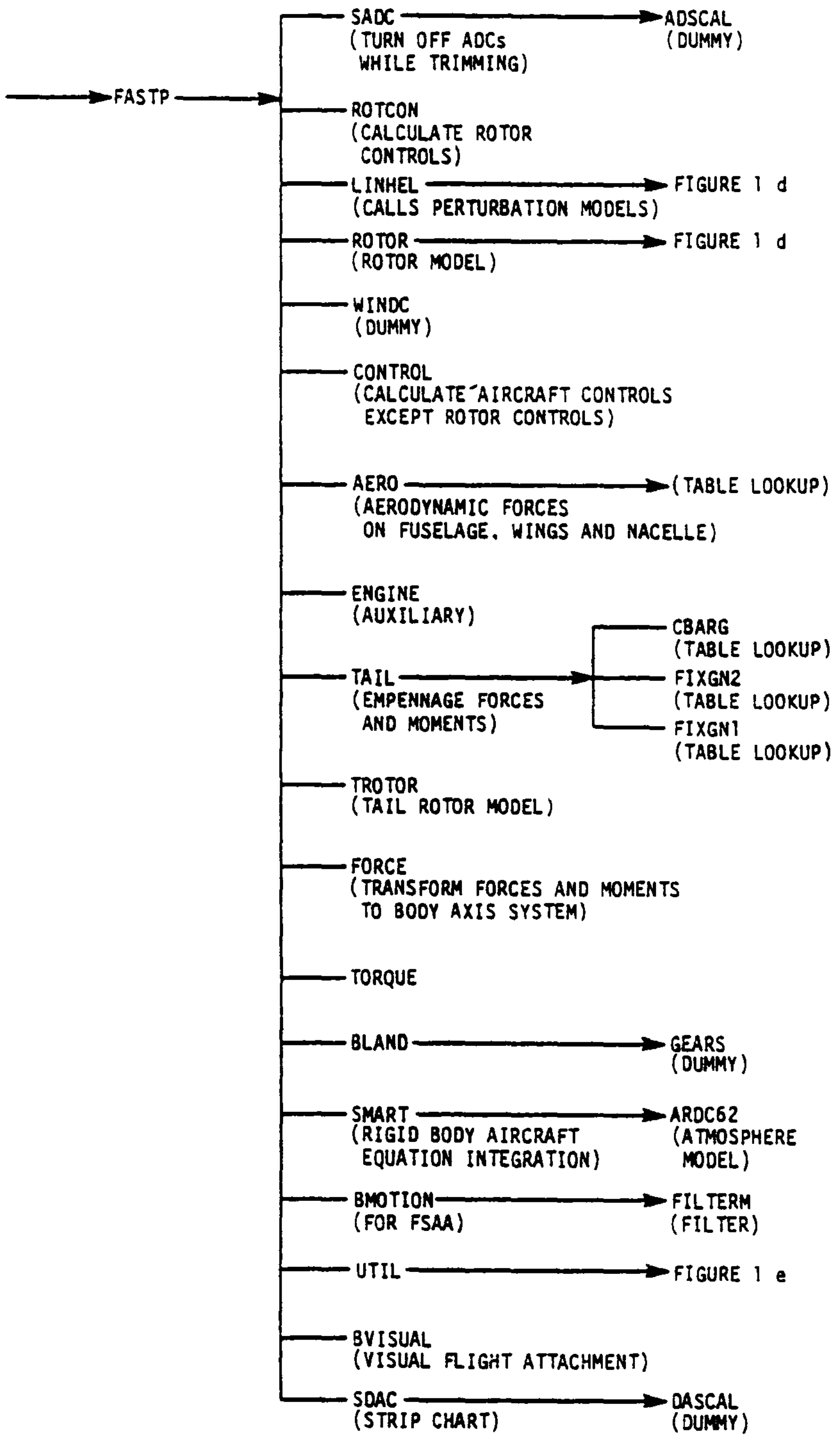


Figure 1c FASTP

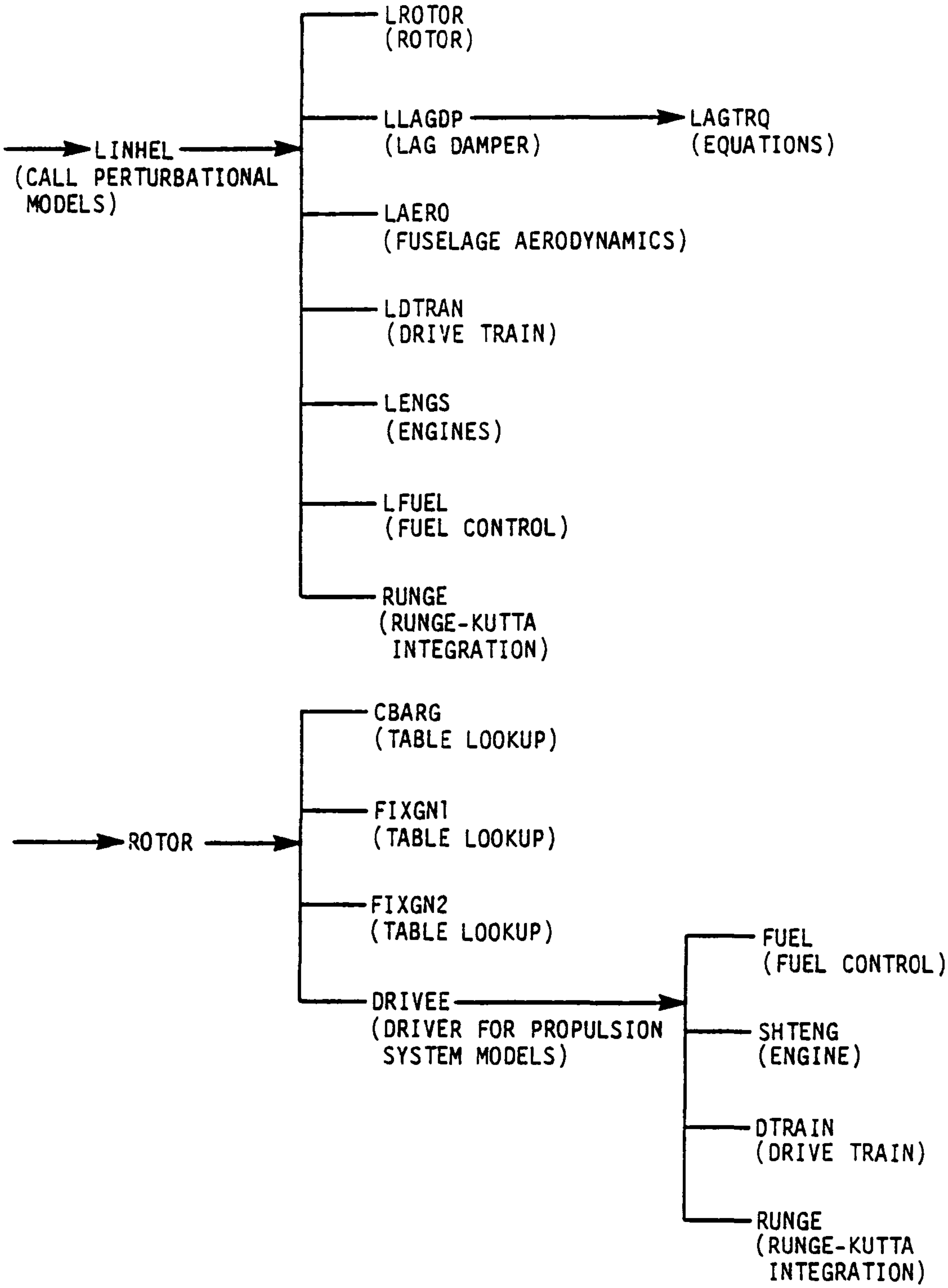


Figure 1d LINHEL and ROTOR

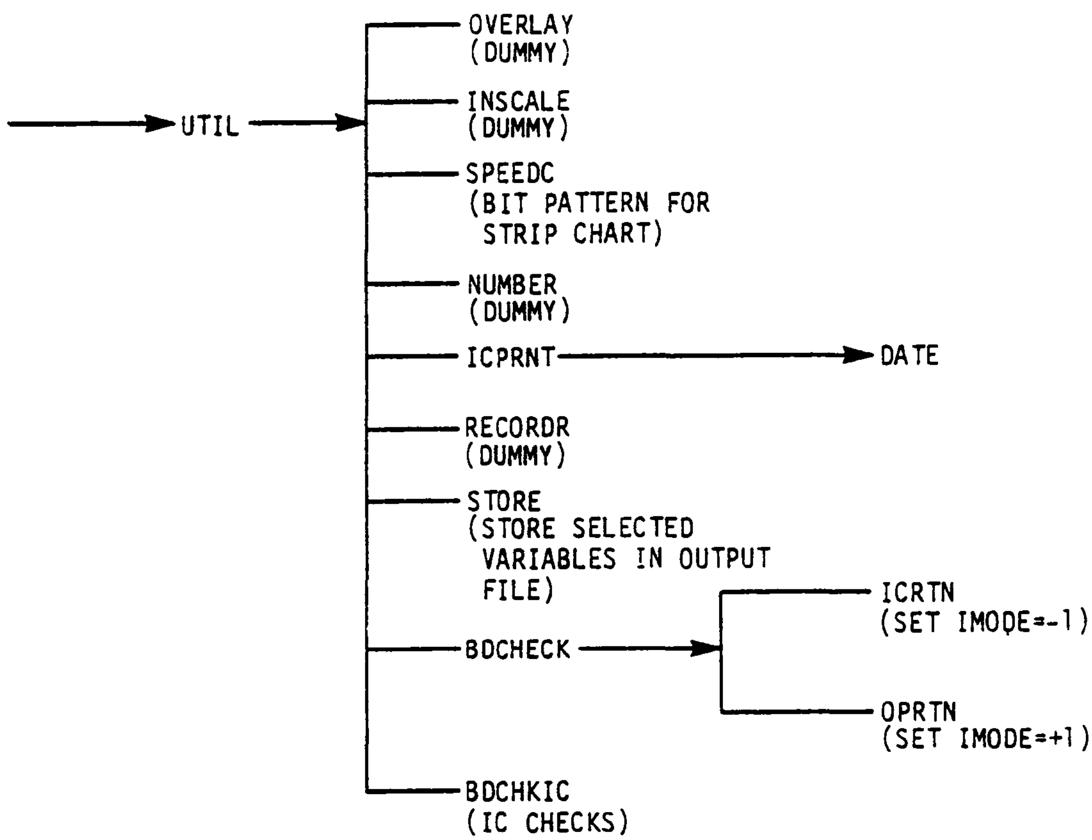
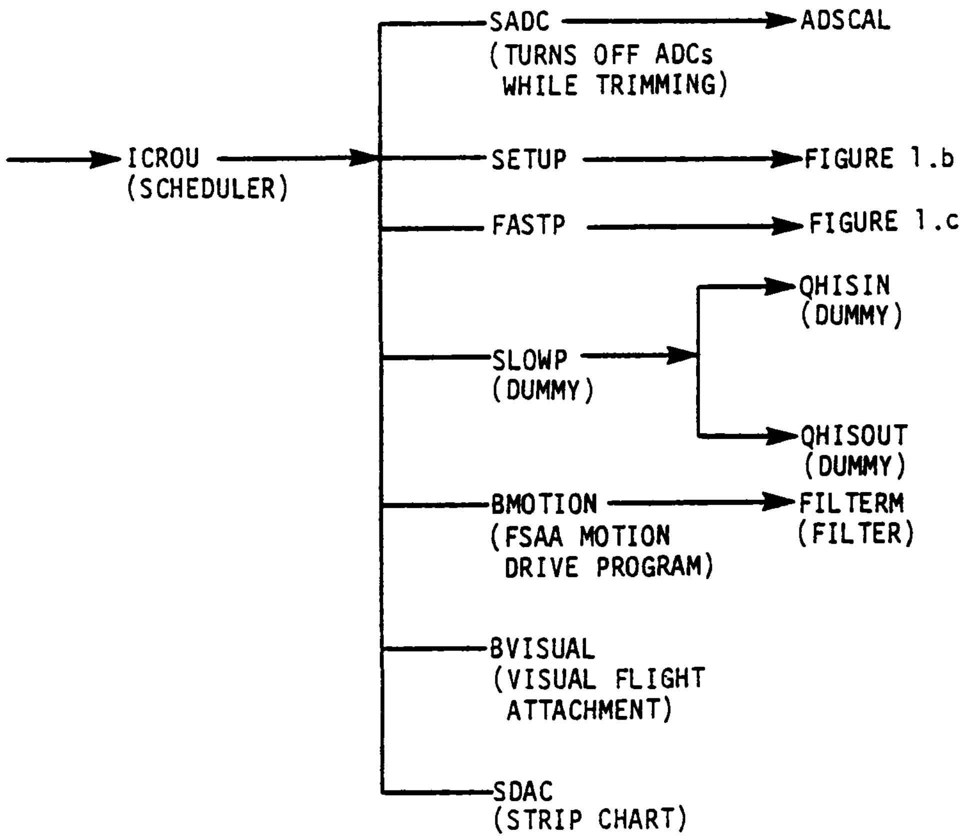


Figure 1e UTIL



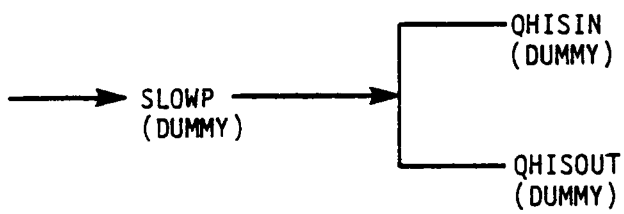


Figure 1f ICROU and SLOWP

```
RUSSS,T120,Y)1,YL1.
ACCOUNT,        ,        .
SETNAME(        )
MOUNT(VSN=       )
REQUEST(TAPE1,*P-)
REQUEST,TAPE2,*PF.
REWIND,INPUT.
COPY,INPUT,TAPE5.
REWIND,TAPE5.
RFL(75000)
ATTACH,NLIB,RSRAL,CY=1.
ATTACH(ULIB,TABLES)
ATTACH,FLIB,SCIFGL.
ATTACH,ELIB,EFTNLL.
ATTACH,LLIB,EFTLL.
LIBRARY(NLIB,ULIB,FLIB,ELIB,LLIB)
MAP,OFF.
RFL(110000)
LIBLOAD(NLIB,DRIVER)
LIBLOAD(NLIB,88)
SLOAD(NLIB/BLOCK,BLOCK)
LDSET(PRESET=ZERO)
EXECUTE.
EXIT(U)
CATALOG,TAPE1,CHECK3,ID=        .
?
 ICRN      100.
 DATA
 1     167  .005          DT1
 1     168  .005          DT2
 1     169  .005          DT3
 1     365  1000.         HRHOZ
 2      61          5     IDT1
 2      62          5     IDT2
 2      63          5     IDT3
 2     141          1     ICOND
 2     164          1     N2
 2     165          1     N3
/
 UDATA
 2      32          2     ISAVE      IRS
 2      42          0     IRPF = IRS(42)
 2      50          0     ILIN = IRS(50)
/
 TRIM      1000.
 UDATA
 2      42          3     IRPF = IRS(42)
/
 TRIM      1000.
 DATA
 1     311        100.    DTD
 1     312       .2838    TEND       A
 1     312         60.    TEND       A
 1     315          0.    AMVECT(3)  A
 1     315         20.    AMVECT(3)  A
 1     350  0.            THOLY
 2     118          3     ICODE      TA
/
 UDATA
 1     299  1.            XA1SAC
 1     300  -1.           XB1SAC
 2      36          1     IPDAMP     SAS
 2      37          1     IQDAMP     SAS
 2      38          1     IRDAMP     SAS
 1     290         10.    TDS = TIME INPUT TO BE APPLIED = RCM(290)
 1     289          1.    TRAMP = RCM(289)
 2      37          1     IRAMP = IRS(37)
/
 PRNT      2.
 DYNC
 PRNT      2.
 END
```

Figure 2 Job Control Language For Executing GENHEL

CAFU =

-8.250	0.	-2.130	0.	0.	-60.30	0.	0.
0.	-90.90	0.	-338.0	0.	3290.	0.	0.
-3.350	0.	-33.30	0.	0.	0.	0.	0.
0.	-170.0	0.	-1550.	0.	.1640E+05	0.	0.
-103.0	0.	-544.0	0.	0.	0.	0.	0.
0.	543.0	0.	.1320E+05	0.	-.1340E+06	0.	0.

CAR =

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	.6200E+05	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

DAC =

0.	0.	0.	0.
0.	0.	0.	134.0
0.	0.	0.	0.
0.	0.	0.	516.0
0.	0.	0.	0.
0.	0.	0.	-4870.

DAI =

0.	0.	0.	0.
0.	0.	9.590	0.
0.	0.	0.	0.
0.	0.	34.10	0.
0.	0.	0.	0.
0.	0.	-410.0	0.

DAFU =

0.	0.	0.	0.	0.	0.	.6700
0.	0.	0.	0.	0.	0.	4.980
0.	0.	-3.620	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	-11.40
0.	0.	-163.0	0.	0.	0.	79.20
0.	0.	0.	0.	0.	0.	-83.00

DARI =

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.930	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Figure 3 Coefficients For Perturbational Fuselage Aerodynamic Model

ARR =

-515.9	0.	0.	0.	0.	56.60	0.	0.	0.	0.
0.	-515.9	232.0	0.	0.	0.	56.60	-229.0	0.	0.
0.	-232.0	-515.9	0.	0.	0.	229.0	56.60	0.	0.
0.	0.	0.	-515.9	465.0	0.	0.	0.	56.60	-459.0
0.	0.	0.	-465.0	-515.9	0.	0.	0.	459.0	56.60
-23.70	0.	0.	0.	0.	-25.68	0.	0.	0.	0.
0.	-23.70	1450.	0.	0.	0.	-25.68	244.0	0.	0.
0.	-1450.	-23.70	0.	0.	0.	-244.0	-25.68	0.	0.
0.	0.	0.	-23.70	2900.	0.	0.	0.	-25.68	487.0
0.	0.	0.	-2900.	-23.70	0.	0.	0.	-487.0	-25.68
-10.50	0.	0.	0.	0.	10.36	0.	0.	0.	0.
0.	-10.50	0.	0.	0.	0.	10.36	0.	0.	0.
0.	0.	-10.50	0.	0.	0.	0.	10.36	0.	0.
0.	0.	0.	-10.50	0.	0.	0.	0.	10.36	0.
0.	0.	0.	0.	-10.50	0.	0.	0.	0.	10.36
-65.40	0.	0.	0.	0.	-11.00	0.	0.	0.	0.
0.	-65.40	0.	0.	0.	0.	-11.00	0.	0.	0.
0.	0.	-65.40	0.	0.	0.	0.	-11.00	0.	0.
0.	0.	0.	-65.40	0.	0.	0.	0.	-11.00	0.
0.	0.	0.	0.	-65.40	0.	0.	0.	0.	-11.00

ART =

0.	2.043	1.240	-8.950	.5610	-3.650	1.050	0.	-3.400	2.100
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

ARFU =

-.6650E-01	.1580	-.4240E-01	.1760	0.	.1250	-.4950E-01	.5110E-01	.1190	-.4890E-01
0.	-.3690	.8100E-01	-.7910E-01	.4900E-01	-.4590E-01	.2290E-01	.2260E-01	-.3600E-01	.2710E-01
1.000	-.3730	-.4980	.3630	0.	-.3040E-01	-.1510	-.2380E-01	.1440	-.5750E-01
0.	-45.60	-23.10	4.340	4.820	-1.800	6.590	6.360	-3.610	0.
-10.10	50.00	112.9	-16.30	0.	7.840	0.	29.50	6.280	-5.230
0.	3.590	3.410	-.3600	-.5610	.6400	-11.15	0.	.5900	-2.100
0.	0.	0.	0.	0.	0.	1.610	0.	0.	0.
-.5610E-01	0.	0.	0.	0.	0.	0.	-1.610	0.	0.

Figure 4 Coefficients of Perturbational Rotor Aerodynamics Model

BKC =

9.130	0.	-5.020	-.5560	0.	-2.640	-1.360	1.630	0.	0.
0.	8.230	0.	0.	2.130	.2190	-2.470	-.5580	1.390	0.
-3.550	0.	7.170	-2.190	0.	.6610	1.470	-2.500	-.1790	.9480
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

BKFU =

-.1740E-02	0.	0.	0.	0.	0.	0.	-.4990E-01	0.	0.
0.	0.	0.	0.	0.	0.	-.4990E-01	0.	0.	0.
.4990E-01	0.	0.	0.	0.	0.	0.	-.1740E-02	0.	0.
0.	0.	1.050	0.	0.	-.3670E-01	-.3180	0.	0.	0.
-.4920E-01	1.050	0.	0.	0.	0.	0.	.3200	0.	0.
0.	0.	.3670E-01	0.	0.	1.050	-.6040E-01	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

BRT =

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	-1.050	0.	0.	0.	0.

BRL =

0.	0.	0.	0.	0.	.5482E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	.5482E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	.5482E-03	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	.5482E-03	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	.5482E-03

CRR =

-.4530E+05	0.	.2250E+06	0.	0.	-.1120E+05
0.	0.	0.	-2740.	.1210E+06	2180.
0.	.1400E+05	0.	.1180E+06	0.	0.
-.1260E+05	0.	0.	-.5150E+05	0.	0.
-8020.	0.	0.	0.	0.	0.
0.	-2850.	0.	0.	0.	-.2410E+06
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	906.0	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	-119.0
0.	0.	0.	1570.	0.	0.
0.	0.	1520.	0.	0.	1210.
-1330.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.

Figure 4 (Continued)

CRT =

-342.0	0.	1540.	0.	-782.0	2830.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.

CRFU =

13.40	0.	9.820	0.	0.	0.
0.	-16.80	0.	0.	0.	0.
18.00	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
.1470E+05	0.	0.	0.	0.	0.
0.	0.	-1500.	0.	0.	-2610.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.

DRC =

0.	0.	-377.0	0.	0.	0.
0.	0.	0.	0.	-77.30	0.
0.	-14.70	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.

DRFU =

0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
-60.70	0.	0.	0.	0.	-7.030
0.	-1132.	0.	0.	0.	0.
6390.	0.	0.	0.	0.	0.
0.	-1105.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.

DRT =

0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	-14.70	0.	0.	-20.70

DRR1 =

0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
-3.450	0.	0.	8.350	5.030	0.
0.	0.	0.	0.	-2.260	0.
0.	0.	0.	0.	0.	30.47
6.630	-16.30	0.	0.	0.	0.
-54.80	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.

Figure 4 (Concluded)

Table 1

Common/XFLOAT/A(500)

COMMON NUMBER	VARIABLE	FORTRAN NAME	UNITS	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
1	ϕ	PHI	deg	BROTATE	Aircraft Euler angles in degrees and radians.
2	θ	THET	deg		
3	ψ	PSI	deg		
4	ϕ	PHIR	rad		
5	θ	THETR	rad		
6	ψ	PSIR	rad		
7	$\dot{\phi}$	PHID	rad/sec		Aircraft Euler angle rates.
8	$\dot{\theta}$	THED	rad/sec		
9	$\dot{\psi}$	PSID	rad/sec		
10	$\sin\phi$	SPHI	ND	BTRANSFO	Sines and cosines of all aircraft Euler angles.
11	$\cos\phi$	CPHI	ND		
12	$\sin\theta$	STHT	ND		
13	$\cos\theta$	CTHT	ND		
14	$\sin\psi$	SPSI	ND		
15	$\cos\psi$	CPSI	ND		
16		T11	ND		Components of the Local-to-Body axes transformation matrix, i.e., $\vec{V}_B = [T_{ij}]\,\vec{V}_L$
17		T21	ND		
18		T31	ND		
19		T12	ND		
20	T_{ij} =	T22	ND		
21		T32	ND		
22		T13	ND		
23		T23	ND		
24		T33	ND		
25	α	ALFA	deg	BALFBET	Angles of attack and sideslip in degrees and radians.
26	β	BETA	deg		
27	α	ALFAR	rad		
28	β	BETAR	rad		
29	$\dot{\alpha}$	ALFD	rad/sec		Angular rates of angles of attack and sideslip.
30	$\dot{\beta}$	BETD	rad/sec		

Table 1 (Continued)

COMMON NUMBER	VARIABLE	FORTRAN NAME	UNITS	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
31	$\sin\alpha$	SALPH	ND	BALFBET	Sines and cosines of angles of attack and sideslip.
32	$\cos\alpha$	CALPH	ND		
33	$\sin\beta$	SBETA	ND		
34	$\cos\beta$	CBETA	ND		
35	γ_V	GAMV	rad	BINERTIA	Inertial flight path angles in the vertical and horizontal planes. γ_H positive clockwise from North.
36	γ_H	GAMH	rad		
37		PB	rad/sec	BROTATE	Body axis components of the aircraft angular velocity wrt inertial space.
38	$\vec{\omega}_{B_I} =$	QB	rad/sec		
39		RB	rad/sec		
40		PL	rad/sec	BINERTIA	Local and body axes components of the angular velocity of the local coordinate system wrt inertial space.
41	$\vec{\omega}_{Y_L} =$	QL	rad/sec		
42		RL	rad/sec		
43		PLB	rad/sec		
44	$\vec{\omega}_{Y_B} =$	QLB	rad/sec		
45		RLB	rad/sec		
46		PT	rad/sec	BROTATE	Body axis components of the angular velocity wrt the Earth, i.e., $\vec{\omega}_{B_L} = \vec{\omega}_{B_I} - \vec{\omega}_{Y_B}$
47	$\vec{\omega}_{B_L} =$	QT	rad/sec		
48		RT	rad/sec		
49		PBWN	rad/sec		Body axis components of the aircraft angular velocity wrt inertial space plus an equivalent angular velocity due to turbulence, i.e., $\vec{\omega}_{BN_I} = \vec{\omega}_{B_I} + \vec{\omega}_N$ (used in computing aerodynamic forces and moments)
50	$\vec{\omega}_{BN_I} =$	QBWN	rad/sec		
51		RBWN	rad/sec		
52		PTURB	rad/sec	BWIND	Body axis components of the equivalent angular velocity due to atmospheric turbulence (gust gradient effects).
53	$\vec{\omega}_N =$	QTURB	rad/sec		
54		RTURB	rad/sec		
55		PBD	rad/sec^2	BROTATE	Body axis components of the aircraft angular acceleration wrt inertial space.
56	$\dot{\vec{\omega}}_{B_I} =$	QBD	rad/sec^2		
57		RBD	rad/sec^2		
58		UB	ft/sec	BVELOCIT	Body axis components of the aircraft velocity wrt the air mass.
59		VB	ft/sec		
60		WB	ft/sec		

Table 1 (Continued)

COMMON NUMBER	VARIABLE	FORTRAN NAME	UNITS	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
61		UTURB	ft/sec	SWIND	Body axis components of the linear velocity due to atmospheric turbulence. (Positive for gust in positive X, Y, or Z direction).
62		VTURB	ft/sec		
63		WTURB	ft/sec		
64		VN	ft/sec	BHORIZON	Local axis components of the aircraft velocity wrt inertial space.
65		VE	ft/sec		
66		VD	ft/sec	BVERTICA	
67		VEE	ft/sec	BHORIZON	Eastward component of the aircraft velocity wrt the earth's surface.
68		VT	ft/sec	BINERTIA	Magnitude of velocity wrt earth's surface, $VT = \sqrt{VN^2 + VEE^2 + VD^2}$
69		VG	ft/sec		Ground speed. Magnitude of horizontal velocity wrt earth's surface, $VG = \sqrt{VN^2 + VEE^2}$
70		VEW	ft/sec	BALFBET	Airspeed, magnitude of velocity wrt air mass.
71	M	XMACH	ND	BATMOSPH	Mach number.
72		VNR	ft/sec	BVELOCIT	Local axis components of the aircraft velocity wrt the air mass.
73		VER	ft/sec		
74		VDR	ft/sec		
75	V_{eq}	VEQ	kt	BATMOSPH	Equivalent airspeed.
76		VNW	ft/sec	WINDC,0.	North, east, and down components of the wind (positive for wind blowing <u>to</u> north, east, or down)
77		VEW	ft/sec		
78		VDW	ft/sec		
79		VTW	ft/sec		Magnitude of wind.
80	$\dot{h}$	ALTD	ft/sec	BVERTICA	Altitude rate, $\dot{h}$ = -VD.
81	$\dot{\tau}$	XLOND	rad/sec	BHORIZON	Rate of change of aircraft longitude.
82	$\dot{\lambda}$	XLATD	rad/sec		Rate of change of aircraft latitude.
83	h	ALT	ft	BVERTICA	Altitude of aircraft wrt sea level.
84	τ	XLON	rad	BHORIZON	Aircraft longitude.
85	λ	XLAT	rad		Aircraft latitude.
86	sin λ	SLAT	ND	BEARTH	Sine of aircraft's latitude.
87	cos λ	CLAT	ND		Cosine of aircraft's latitude.

Table 1 (Continued)

COMMON NUMBER	VARIABLE	FORTRAN NAME	UNITS	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
88		VND	ft/sec^2	BHORIZON	Derivatives of local axis components of aircraft velocity wrt inertial space.
89		VED	ft/sec^2		
90		VDD	ft/sec^2	BVERTICA	
91		AX	ft/sec^2	BACCELER	Body axis components of specific force (accelerometer output) at the aircraft's cg.
92	$\vec{A}_{cg} =$	AY	ft/sec^2		
93		AZ	ft/sec^2		
94		AXP	ft/sec^2		Body axis components of specific force at the pilot station.
95	$\vec{A}_{pilot} =$	AYP	ft/sec^2		
96		AZP	ft/sec^2		
97	g	G	ft/sec^2	BEARTH	Acceleration due to gravity, 32.2 at h=0.
98		XDDS	ft/sec^2	0.	Reserved for simulator drives (i.e., the researcher could supply commands different from those calculated by BBEND).
99		YDDS	ft/sec^2	0.	
100		ZDDS	ft/sec^2	0.	
101	V_c	VCAL	kt	BATMOSPH	Calibrated airspeed.
102		HWEEL	ft	BVERTICA	Approximate height of main gear above runway.
103		XPR	ft	BHORIZON	Distance of pilot down the runway.
104		YPR	ft		Distance of pilot to the right of the runway.
105		HPR	ft		Height of pilot above the runway.
106		DNR	ft		Northward and Eastward distance of the aircraft c.g. from the runway threshold.
107		DER	ft		
108		RR	ft	BSETUP	Radius of earth plus altitude of runway (HR).
109		RTV	ft	BEARTH	Radius of earth plus altitude of aircraft (ALT).
110	θ_R	THETRR	deg	90.	Runway heading from North (cockwise position).
111	λ_R	XLATR	rad	0.	Latitude of the runway.
112	τ_R	XLONR	rad	0.	Longitude of the runway.
113	$\cos \lambda_R$	CLATR	ND	BSETUP	Cosine of the runway latitude.

Table 1 (Continued)

COMMON NUMBER	VARIABLE	FORTRAN NAME	UNITS	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
114	$\sin \theta_R$	STHETR	ND	BSETUP	Sine and cosine of the runway heading.
115	$\cos \theta_R$	CTHETR	ND		
116	I_X	XIXX	$slug\text{-}ft^2$		Moments and product of inertia in the aircraft body axis.
117	I_Y	XIYY	$slug\text{-}ft^2$		
118	I_Z	XIZZ	$slug\text{-}ft^2$		
119	I_{XZ}	XIXZ	$slug\text{-}ft^2$		
120		XMC1	ND		Moment of inertia coefficients used to compute angular accelerations. Definitions are contained in Appendix A.
121		XMC2	ND		
122		XMC3	$slug^{-1}\text{-}ft^{-2}$		
123		XMC4	$slug^{-1}\text{-}ft^{-2}$		
124	c_i =	XMC5	ND		
125		XMC6	ND		
126		XMC7	$slug^{-1}\text{-}ft^{-2}$		
127		XMC8	ND		
128		XMC9	ND		
129		XMC10	$slug^{-1}\text{-}ft^{-2}$		
130	m	XMASS	slug		Aircraft mass.
131	C_L	CL	ND	AERO2	Lift and drag coefficients (stability axis)
132	C_D	CD	ND		
133	C_X	CX	ND		Non-dimensional force coefficients (body axis).
134	C_Y	CY	ND		
135	C_Z	CZ	ND		
136		FAX	lb		Body axis components of the aerodynamic forces.
137	$\vec{F}_A$ =	FAY	lb		
138		FAZ	lb		
139		FEX	lb	ENGINE	Body axis components of the applied forces due to the engines.
140	$\vec{F}_E$ =	FEY	lb		
141		FEZ	lb		

Table 1 (Continued)

COMMON NUMBER	VARIABLE	FORTRAN NAME	UNITS	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
142		FGX	lb	BLGC	Body axis components of the applied forces due to the landing gear.
143	$\vec{F}_G =$	FGY	lb		
144		FGZ	lb		
145		FTX	lb	BFTOTAL	Sum of forces due to aerodynamic loads, the engines, and the landing gear.
146	$\vec{F}_T =$	FTY	lb		
147		FTZ	lb		
148		FN	lb	BHORIZON	$\vec{F}_{T_E} = [T_{ij}]^T \vec{F}_T$ = the local axis components of the total applied force acting on the aircraft.
149	$\vec{F}_{T_E} =$	FE	lb		
150		FD	lb	BVERTICA	
151		FG	lb	BEARTH	Force due to gravity, mg, at altitude ALT.
152	C_l	CLL	ND	AERO2	Coefficients of aerodynamic rolling, pitching, and yawing moments.
153	C_m	CLM	ND		
154	C_n	CLN	ND		
155		TAL	ft-lb		Body axis components of the applied torque due to aerodynamic loads.
156	$\vec{T}_A =$	TAM	ft-lb		
157		TAN	ft-lb		
158		TEL	ft-lb	ENGINE	Body axis components of the applied torque due to the engines.
159	$\vec{T}_E =$	TEM	ft-lb		
160		TEN	ft-lb		
161		TGL	ft-lb	BLGC	Body axis components of the applied torque due to the landing gear.
162	$\vec{T}_G =$	TGM	ft-lb		
163		TGN	ft-lb		
164		TTL	ft-lb	BTORQUE	Sum of torques due to aerodynamic loads, the engines, and the landing gear.
165	$\vec{T}_T =$	TTM	ft-lb		
166		TTN	ft-lb		
167	Δt_1	DT1	sec	BSETUP	First loop frame time = IDT1/1000.
168	Δt_2	DT2	sec		Second loop frame time = N2*DT1.
169	Δt_3	DT3	sec		Third loop frame time = N3*DT1.
170	h_R	HR	ft	0.	Altitude of runway wrt sea level.

Table 1 (Continued)

COMMON NUMBER	VARIABLE	FORTRAN NAME	UNITS	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
171		XP	ft	87.	
172		YP	ft	0.	Coordinates of the pilot in aircraft body axes.
173		ZP	ft	-2.75	
174		XCG	ft	BEARTH	
175		YCG	ft	↓	Coordinates of the aircraft c.g. wrt the runway axis system.
176		HCG	ft	BVERTICA	
177	W	WAIT	lb	BSETUP	Weight of aircraft at sea level ($g \triangleq 32.2$).
178	$\bar{q}$	QBAR	lb/ft^2	BATMOSPH	Dynamic pressure.
179	$\bar{q}_c$	QBARC	lb/ft^2	↓	Impact pressure.
180	S	AREA	ft^2	0.	Wing area.
181	b	SPAN	ft	0.	Wing span.
182	$\bar{c}$	CHORD	ft	27.66	Wing mean aerodynamic chord.
183	ρ	RHO	$slug/ft^3$	BATMOSPH	Air density at altitude ALT.
184		XTAIL	ft	-63.2	Coordinates of the aircraft tail wrt the aircraft body axis system.
185		ZTAIL	ft	1.07	
186		HTAIL	ft	BLGA	Height of tail above runway.
187		XNG	ft	50.	
188		YNG	ft	0.	Coordinate of the nose gear wrt the aircraft body axis system.
189		ZNG	ft	16.3	
190		XRG	ft	-5.0	
191		YRG	ft	12.6	Coordinate of the right main gear wrt the aircraft body axis system.
192		ZRG	ft	14.58	
193		XLG	ft	-5.0	
194		YLG	ft	-12.6	Coordinate of the left main gear wrt the aircraft body axis system.
195		ZLG	ft	14.58	
196		XOE	ft	0.	
197		YOE	ft	20.0	Coordinates of the right wing outboard engine wrt the aircraft body axis system.
198		ZOE	ft	0.	

Table 1 (Continued)

COMMON NUMBER	VARIABLE	FORTRAN NAME	UNITS	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
199		XIE	ft	0.	Coordinates of the right wing inboard engine wrt the aircraft body axis system.
200		YIE	ft	15.8	
201		ZIE	ft	0.	
202		HTAILD	ft/sec	BLGA	Rate of change of tail height.
203		DSTN	ft		Gear strokes for nose, right and left gear. (Negative for oleo compression).
204		DSTR	ft		
205		DSTL	ft		
206		DSTND	ft/sec		Gear stroke rates for nose, right and left gear.
207		DSTRD	ft/sec		
208		DSTLD	ft/sec		
209	a	SOUND	ft/sec	BATMOSPH	Speed of sound at altitude ALT.
210		FOLEO1	lb	GEARS	Oleo forces on aircraft due to the nose, right and left gears (normal to runway, positive down).
211		FOLEO2	lb		
212		FOLEO3	lb		
213		FRICT1	lb		Friction forces on aircraft due to the nose, right and left gears (parallel to runway, positive forward).
214		FRICT2	lb		
215		FRICT3	lb		
216		FSIDE1	lb		Side forces on aircraft due to the nose, right and left gears (ground plane, positive right).
217		FSIDE2	lb		
218		FSIDE3	lb		
219		FRXP1	lb	BLGB	Body axis components of the total landing gear forces on the nose, right and left gears.
220		FRXP2	lb		
221		FRXP3	lb		
222		FRYP1	lb		
223		FRYP2	lb		
224		FRYP3	lb		
225		FRZP1	lb		
226		FRZP2	lb		
227		FRZP3	lb		

Table 1 (Continued)

COMMON NUMBER	VARIABLE	FORTRAN NAME	UNITS	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
228		FRTAIL	lb	GEARS	Normal and drag forces on aircraft due to a tail strike (positive down and forward).
229		FRICTT	lb		
230	ϕ_{ic}	PHIIC	deg	0.	Initial values of the aircraft Euler angles.
231	θ_{ic}	THETIC	deg	0.	
232	ψ_{ic}	PSIIC	deg	90.	
233	$\gamma_{V_{ic}}$	GAMVIC	deg	0.	Initial conditions of inertial flight path angles in the vertical and horizontal planes.
234	$\gamma_{H_{ic}}$	GAMHIC	deg	90.	
235		PBIC	deg/sec	0.	Initial conditions of the body axis components of the aircraft angular velocity wrt inertial space.
236		QBIC	deg/sec	0.	
237		RBIC	deg/sec	0.	
238	V_{eq}	VEQIC	kt	150.	Initial condition of the equivalent airspeed.
239		XIC	ft	-7000.	Initial condition of <u>either</u> the pilot or aircraft c.g. wrt the runway axis system (ICG = 0 or 1).
240		YIC	ft	0.	
241		HIC	ft	500.	
242	W_{ic}	WAITIC	lb	209128.	Initial condition of aircraft weight.
243	$I_{X_{ic}}$	XIXXIC	slug-ft^2	1193151.7	Initial conditions of the moments and product of inertia.
244	$I_{Y_{ic}}$	XIYYIC	slug-ft^2	9891068.3	
245	$I_{Z_{ic}}$	XIZZIC	slug-ft^2	10888744.5	
246	$I_{XZ_{ic}}$	XIXZIC	slug-ft^2	-213555.	
247		XREDCO	volts	BVISUAL	Linear position commands to the Redifon servos.
248		YREDCO	volts		
249		HREDCO	volts		
250		XREDFU	volts	ADC	Redifon follow-ups from position pots for X, Y, and H.
251		YREDFU	volts	ADC	
252		HREDFU	volts	ADC	
253		PHIRED	volts	BVISUAL	Angular position commands to the Redifon servos.
254		THTRED	volts		
255		PSIRED	volts		
256		CG	%	51.4	Location of aircraft c.g. wrt the leading edge of the MAC.

Table 1 (Continued)

COMMON NUMBER	VARIABLE	FORTRAN NAME	UNITS	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
257		XREC	ft	DNS10B	Variable sensitivity values of XCG and HCG used for the strip chart recorders (see discussion at DNS10B).
258		HREC	ft		
259	ϵ_{GS}	EPSGS	deg		Glide slope error (positive for aircraft high).
260	ϵ_{LOC}	EPSLOC	deg		Localizer error (positive for aircraft to the right).
261		HDOTI	volts		Command signal to the cab IVSI.
262		RSCALE	ND	600.	Redifon model scene scale factor.
263		XZRED	ft	0.	
264		YZRED	ft	0.	X, Y, and H biases for the Redifon.
265		HZRED	ft	0.	
266		VFINE	kt	DNS10B	Variable limit values of V_c and HCG used for the strip chart recorders (see discussion at DNS10B).
267		HFINE	ft		
268		HRADIO	volts		Command signal to the cab radio altimeter.
269		VIASI	volts		Command signal to the cab calibrated airspeed instrument.
270		TUP	deg	-.5	Orientation of pilot's viewing angle wrt the aircraft body axis (but normally used for pitch and heading biases for the Redifon servos).
271		TRITE	deg	3.	
272		XPGS	ft	1000.	X and Y coordinates of the glide slope transmitter wrt the runway axis.
273		YPGS	ft	0.	
274		THETGS	deg	2.65	Angle of the glide slope transmitter (positive up).
275		XPLOC	ft	13200.	X and Y coordinates of the localizer transmitter wrt the runway axis.
276		YPLOC	ft	0.	
277		AMEG	deg	27.25	Half angle of outer and middle markers.
278		XOM	ft	-26400.	
279		YOM	ft	0.	Coordinates of the outer and middle markers wrt the runway axis system.
280		XMM	ft	-3500.	
281		YMM	ft	0.	
282		SPEED	mm/sec	DNS10B	Speed of strip chart recorders.
283		HFLARE	ft	0.	Flare initiation altitude (see IFLARE).
284		HT[illegible]	ft	ADC	Optional selective altitude (set from Cab).

Table 1 (Continued)

COMMON NUMBER	VARIABLE	FORTRAN NAME	UNITS	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
285		- - -			Not used.
286		DIST35	ft	0.	X-distance to 35 foot obstacle clearance plane.
287	σ_u	UDISP	ft/sec	WINDC	RMS levels of the u and w components of the turbulence.
288	σ_w	WDISP	ft/sec		
289	L_u	UAL	ft		Scale lengths used by the MIL-F-8785 turbulence model.
290	L_w	WAL	ft		
291	σ	DISP	ft/sec	0.	RMS level of the turbulence.
292		- - -			Not used.
293		- - -			Not used.
294		CGZER	%	51.4	Initial and incremental values of the aircraft c.g. wrt the leading edge of the MAC.
295		CGDELT	%	0.	
296		DME	ft	INS10B	Distance from the glide slope source to the pilot.
297		XBLOC	ft	0.	
298		YBLOC	ft	0.	Coordinates of the localizer receiver wrt the aircraft axis system.
299		ZBLOC	ft	0.	
300		XBGS	ft	0.	
301		YBGS	ft	0.	Coordinates of the glide slope receiver wrt the aircraft axis system.
302		ZBGS	ft	0.	
303	t	TIME	sec	BROTATE	Time from start of Operate.
304		HFOGB	ft	700.	Fog ceiling (clear below HFOGB).
305		- - -			
306		FLEVEL	volts	BVISUAL	Command signal to fog generating equipment.
307		- - -			
308		SCSPDA	mm/sec	2.	
309		SCSPDB	mm/sec	5.	SPEED=Speed of strip chart recorder= {SCSPDA for ALT≤HTSCSW; SCSPDB for ALT>HTSCSW}
310		HTSCSW	ft	200.	
311		DTD	sec	2.	Duration of dynamic check pulse.
312		TEND	sec	25.	End time of dynamic response sequence.

Table 1 (Continued)

COMMON NUMBER	VARIABLE	FORTRAN NAME	UNITS	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
313		DCVAL1	-	3.2	Amplitudes of dynamic check inputs 1, 2, and 3.
314		DCVAL2	-	9.55	Amplitudes of dynamic check inputs 1, 2, and 3.
315		DCVAL3	-	4.27	Amplitudes of dynamic check inputs 1, 2, and 3.
316		PTCHOT	volts	0.	Optional command signals to a pitch, rudder, and left and right elevon instruments.
317		RUDROT	volts	0.	Optional command signals to a pitch, rudder, and left and right elevon instruments.
318		ELVLOT	volts	0.	Optional command signals to a pitch, rudder, and left and right elevon instruments.
319		ELVROT	volts	0.	Optional command signals to a pitch, rudder, and left and right elevon instruments.
320		GUTIM	sec	12.	Landing up and down transit times.
321		GDTIM	sec	1.	Landing up and down transit times.
322		VSIN	ND	INS10B	Command signals to an optional velocity meter.
323		VCOS	ND	↓	Command signals to an optional velocity meter.
324		VLSIN	ND	↓	Command signals to an optional velocity meter.
325		VLCOS	ND	↓	Command signals to an optional velocity meter.
326		GGAIN1	ND	0.	Gains used by an optional runway rumble model.
327		GGAIN2	ND	0.	Gains used by an optional runway rumble model.
328		GGAIN3	ND	0.	Gains used by an optional runway rumble model.
329		GGAIN4	ND	0.	Gains used by an optional runway rumble model.
330		VIAS3	volts	INS10B	Command signal to PEC calibrated airspeed instrument.
331		HTSELR	ft	0.	Minimum decision altitude.
332		TR	ND	BATMOSTH	Ratio of total to ambient temperature.
333		PR	ND	↓	Ratio of total to ambient pressure.
334		VIAS2	volts	INS10B	Command signal to co-pilot's calibrated airspeed instrument.
335		- - -			Not used.
336		- - -			Not used.
337		- - -			Not used.
338		- - -			Not used.
339		- - -			Not used.
340		- - -			Not used.
341		- - -			Not used.

Table 1 (Continued)

COMMON NUMBER	VARIABLE	FORTRAN NAME	UNITS	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
342		- - -			Not used.
343		- - -			
344		- - -			
345		- - -			
346		PHIOFF	deg	0.	Roll bias used by the Redifon.
347		- - -			Not used.
348		TRISE	sec	0.	Rise and fall times used by the dynamic check program.
349		TFALL	sec	0.	
350		CGINS	volts	INS10B	Command signal to c.g. instrument
351		- - -			Not used.
352		- - -			Not used.
353		PSIDR	volts	INS10A	Command signal to the HSI.
354		VCLLIM	volts	UTIL3	Command to velocity limit instrument (optional).
355		XMREC	ft	UTIL3	Reserved alternate method of recording X on strip chart recorder.
356		TAU	sec	0.	Time constant of first order lag used to drive the Redifon during IC.
357		- - -			Not used.
358		D2R	rad/deg	0.01745329	Used to convert from degrees to radians.
359		R2D	deg/rad	57.2957795	Used to convert from radians to degrees.
360		ZNZE1	ND	BWIND, 1.54237	Starting values used by random noise sources of the MIL-F-8785 turbulence model.
361		ZNZE2	ND	BWIND, 3.52431	
362		ZNZE3	ND	BWIND, 0.72737	
363		ZNZE4	ND	BWIND, 0.55550	
364	ρ_o	RHOZ	$slug/ft^3$	BATMOSPH	Density at sea level, standard day.
365		HRHOZ	ft	BATMOSPH	Altitude used to calculate ρ if ICOND=1 (constant density).
366	T	TAMB	deg K	BATMOSPH	Ambient temperature.
367	P	PAMB	lb/ft^2	BATMOSPH	Ambient pressure.
368	T_t	TTOT	deg K	BATMOSPH	Total temperature.
369	P_t	PTOT	lb/ft^2	BATMOSPH	Total pressure.
370		DELTAT	deg K	0.	Incremental ambient temperature (optional).

Table 1 (Continued)

COMMON NUMBER	VARIABLE	FORTRAN NAME	UNITS	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
371		VIAS5	volts	INS10B	Command signal to copilot's airspeed instrument.
372		PHIFU	volts	ADC	Redifon follow-ups from position pots for Φ, Θ, and Ψ.
373		THTFU	volts		
374		PSIFU	volts		
375		XMCC1	1/sec	BSETUP	Coefficients of angular momentum of rotating machinery used to compute angular accelerations. Definitions are contained in Appendix A.
376		XMCC2	1/sec		
377		XMCC3	1/sec		
378		XMCC4	1/sec		
379		XMCC5	1/sec		
380		XMCC6	1/sec		
381		XMCC7	1/sec		
382		EOMX	slug-ft^2/sec	0.	Body axis components of angular momentum due to rotating machinery.
383		EOMY	slug-ft^2/sec	0.	
384		EOMZ	slug-ft^2/sec	0.	
385		PBDPL	rad/sec^2	0.	Angular accelerations input to the BMOTION subroutine when the flexible aircraft option is on (IFLEX=1). They are <u>not</u> integrated.
386		QBDPL	rad/sec^2	0.	
387		RBDPL	rad/sec^2	0.	
388		DFPHI	rad	0.	Perturbation Euler angles added to the Redifon servo commands computed in the BVISUAL subroutine (used to simulate body bending).
389		DFTHT	rad	0.	
390		DFPSI	rad	0.	
391	$\dot{p}'_B$	STATE1	rad/sec^2	BQUIET	Intermediate variables used by the trim subroutine, BQUIET.
392	$\dot{q}'_B$	STATE2	rad/sec^2		
393	$\dot{r}'_B$	STATE3	rad/sec^2		
394	$\dot{u}'_B$	STATE4	ft/sec^2		
395	$\dot{v}'_B$	STATE5	ft/sec^2		
396	$\dot{w}'_B$	STATE6	ft/sec^2		
397		CTRIM1	-		Controls used to trim the aircraft. The trim subroutine, BQUIET, systematically varies these variables until the linear and angular accelerations meet certain error criteria.
398		CTRIM2	-		
399		CTRIM3	-		
400		CTRIM4	-		
401		CTRIM5	-		
402		CTRIM6	-		

Table 1 (Concluded)

COMMON NUMBER	VARIABLE	FORTRAN NAME	UNITS	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
403		PSIRED	volts	BVISUAL	Course and fine heading command signals used by the Redifon servos.
404		PSIBLK	volts	↓	
405		DTUSED	sec	SMAIN	Frame time of ADC/DAC serving.
406		UBIC	ft/sec	0.	Body axis components of the initial aircraft velocity wrt the wind. Used to specify the initial aircraft velocity if the switch IMACH = -1.
407		VBIC	ft/sec	0.	
408		WBIC	ft/sec	0.	
409		RESTR1	ND	-	Two words used to specify the name of the realtime overlay (EBCDIC).
410		RESTR2	ND	-	
411	L_v	VAL	ft	WINDC	Scale length used by the turbulence model.
412	σ_v	VDISP	ft/sec	WINDC	RMS level of the v component of turbulence.
413		UBD	ft/sec^2	BALFBET	Body axis components of the aircraft acceleration wrt the air mass.
414		VBD	ft/sec^2		
415		WBD	ft/sec^2	↓	
416		VTWN	ft/sec	BVELOCIT	Local axis components of the wind plus random gusts (atmospheric turbulence).
417		VTWE	ft/sec		
418		VTWD	ft/sec		
419		VNTURB	ft/sec		Local axis components of the random gusts (atmospheric turbulence).
420		VETURB	ft/sec		
421		VDTURB	ft/sec	↓	
422		ZERO	ND	0.	This variable is assigned to all unused DAC's.
423		ACYCLE	ND	BVISUAL	Floating point representation of ICYCLE.
424	P/P_o	PAMBR	ND	BATMOSPH	Ratio of ambient to sea level pressure.
425	T/T_o	TAMBR	ND	↓	Ratio of ambient to sea level temperature.
426	tan λ	TLAT	ND	BEARTH	Tangent of the aircraft's latitude.

Table 2

Common/IFIXED/IA(200)

COMMON NUMBER	FORTRAN NAME	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
1	IMODE	MOTHER	Mode control integer.
2	INGT	BLGA	Nose gear on ground*.
3	IRGT		Right main gear on ground*.
4	ILGT		Left main gear on ground*.
5	ISTRIK		Tail on ground*.
6	IFLAT	0	Flat earth option*.
7	IFFCI	0	Fixed-flight de-bug in progress.
8	ISINW	BDCHEK5	Sine wave input.
9	IHIT	BLGA	Ground touched by wheel or tail*.
10	IWEEL	INS10B	Landing gear down*.
11	IWEELC	0	Command landing gear down*.
12	ILGTRN	INS10B	Landing gear in transit*.
13	IOM		Over outer marker*.
14	IMM		Over middle marker*.
15	IAIR		Airways busy*.
16	IFLARE		Below flare height*.
17	I200		Below 200 feet*.
18	I1500		Below 1500 feet*.
19	IBURN	ENGINE	Confirm afterburning occurring*.
20	ISHAKE	0	Shake stick, stall*.
21	IEVAL	BQUIET	Primary trim evaluation flip-flop.
22	ICYCLE	INS10B	Cycling computer off-line indicator
23	ITPROG	BQUIET	Satisfactory trim progress.
24	IFROM	0	Aircraft moving away from beacon.
25	IMDA	INS10B	Altitude trip pilot light, pilot selective.

* Variable = 1 for condition indicated; otherwise zero.

Table 2 (Continued)

COMMON NUMBER	FORTRAN NAME	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
26	IMD1	- - -	Used by EAI 8400 only.
27	IMD2	- - -	Used by EAI 8400 only.
28	IMD3	- - -	Used by EAI 8400 only.
29	IAND	DI, 0	Trim tab, nose down*.
30	IANU	↓	Trim tab, nose up*.
31	IANL		Trim tab, nose left*.
32	IANR		Trim tab, nose right*.
33	ILWD		Trim tab, left wing down*.
34	IRWD		Trim tab, right wing down*.
35	IEBURN		Enable afterburners*.
36	IPDAMP		Activate roll dampers*.
37	IQDAMP		Activate pitch dampers*.
38	IRDAMP		Activate yaw dampers*.
39	IREC1		Reverse thrust discrete, engine 1*.
40	IREC2		Reverse thrust discrete, engine 2*.
41	IREC3		Reverse thrust discrete, engine 3*.
42	IREC4		Reverse thrust discrete, engine 4*.
43	IEGAG1		Command autothrottle activation*.
44	IEGAG2		Select mach hold mode*.
45	IEGAG3		Select IAS hold mode*.
46	IEGAG4		Select IAS select mode*.
47	IAUT1		Skew rate, forward slow*.
48	IAUT2		Skew rate, forward fast*.
49	IAUT3		Skew rate, aft slow*.
50	IAUT4		Skew rate, aft fast*.
51	IABRAK		Activate air brakes*.
52	IPARAC		Activate parachute*.
53	IVISRE	↓	Lower visre*.

* Variable = 1 for condition indicated; otherwise zero.

Table 2 (Continued)

COMMON NUMBER	FORTRAN NAME	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
54	LCAB	DI, 0	Activate INSCAL device*.
55	NLONG	5	Long side count, strip chart DAC multiplexing.
56	NSHORT	2	Short side count, strip chart DAC multiplexing.
57	IFAIL1	DI, 0	Failure of Engine No. 1.
58	IFAIL2	↓	Failure of Engine No. 2.
59	IFAIL3	↓	Failure of Engine No. 3.
60	IFAIL4	↓	Failure of Engine No. 4.
61	IDT1	22	Fastest loop time in milliseconds.
62	IDT2	SMAIN, 44	2nd fastest loop time in milliseconds.
63	IDT3	SMAIN, 88	3rd fastest loop time in milliseconds.
64	ICG	0	Input positions are c.g. relative to runway*.
65	ID	SMAIN	MOTHER initialization integer.
66	IMREQ	-1	Requested mode.
67	IMCAB	0	Mode control in the cab*.
68	IMSECS	1	Mode control at the SECS station*.
69	IMHIS	1	Mode control through the HIS rack*.
70	NDI	128	Number of input discretes.
71	NDO	192	Number of output discretes.
72	NAD	64	Number of ADC's.
73	NDA	128	Number of DAC's.
74	INDEXT	0	Coded trim select.
75	NOLAG	0	Coded quantity under trim control.
76	IABOVE	INS10B	Above obstacle plane*.
77	IBELOW	INS10B	Below obstacle plane*.
78	IDYNCH	0	Dynamic check request.
79	NS1	SPEEDC	Used for strip chart speed control.
80	NS2	↓	Used for strip chart speed control.
81	NS3	↓	Used for strip chart speed control.
82	NS4	↓	Used for strip chart speed control.

* Variable = 1 for condition indicated; otherwise zero.

Table 2 (Continued)

COMMON NUMBER	FORTRAN NAME	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
83	ISHOW	0	Takeoff or landing printout enable*.
84	INUMBER	0	Numbering option enabled*.
85	ITASYL	INS10B	Thrust assymetry, yaw left*.
86	ITASYR	INS10B	Thrust assymetry, yaw right*.
87	INALG1	- - -	Not used.
88	INALG2	- - -	
89	INALG3	- - -	
90	ICH1	- - -	Reserved for any special purpose switches.
91	ICH2	- - -	
92	ICH3	- - -	
93	ICH4	- - -	
94	ICH5	- - -	
95	ICH6	- - -	
96	ICH7	- - -	
97	ICH8	- - -	
98	ICH9	- - -	
99	ICH10	- - -	
100	ICH11	- - -	
101	ICH12	- - -	
102	ITRIM	BQUIET, 0	Aircraft is trimming*.
103	ITRMP	BQUIET	Past value of ITRMCM.
104	IPRINT	0	Enable printout routine*.
105	NRUN	SLOOP1	Run number.
106	IRE1	ENGINE	Engine 1 reversing*.
107	IRE2		Engine 2 reversing*.
108	IRE3		Engine 3 reversing*.
109	IRE4		Engine 4 reversing*.
110	ICHART	INS10B	Strip chart recorders on*.
111	ITRMCM	0	Initiate the trim program*.

* Variable = 1 for condition indicated; otherwise zero.

Table 2 (Continued)

COMMON NUMBER	FORTRAN NAME	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
112	IYBEND	0	Enable Y bending mode*.
113	IZBEND	0	Enable Z bending mode*.
114	IMACH	0	Initial velocity condition is coded†.
115	IFULLV	0	Not used.
116	IFOGIT	BVISUAL	Socked in discrete*.
117	IDUMFU	0	Dummy motion follow-ups enabled*.
118	ICODE	17	Coded dynamic check sequence, see BDCHK5.
119	IGAMTM	0	Trim mode, when enabled, is on gamma.
120	IDISIE	1	Enable input discretes*.
121	IDISOE	1	Enable output discretes*.
122	IASFLP	INS10B	IAS flip-flop.
123	ISITR	0	Right hand controls in command*.
124	ICPRNT	0	Print initial conditions*.
125	IRUMBL	0	Enable runway rumble*.
126	IRUND	0	RUNDUM enable*.
127	IGS2	- INS10B	Inside middle marker event*.
128	IEVENT	DI, 0	Pilot event*.
129	ILGUP	INS10B	Landing gear up*.
130	IEFAIL	INS10B	At least one engine failed*.
131	NCOPY	1	Number of print copies requested.
132	IPSIDR	INS10A	Heading instrument drive discrete (see PSIDR).
133	IPEN1	DO, 0	X-Y plotter pen down command, Recorder 1*.
134	IPEN2	↓	X-Y plotter pen down command, Recorder 2*.
135	IPEN3	↓	X-Y plotter pen down command, Recorder 3*.
136	NEWNZE	0	Option for non-repeatable turbulence*.
137	ITUB	- - -	Not used.

* Variable = 1 for condition indicated; otherwise zero.

† If IMACH =
- 1 use VEQIC as initial Mach number
- 0 use VEQIC as initial equivalent airspeed
- -1 use UBIC, VBIC, and WBIC as initial velocity components relative to air mass

Table 2 (Continued)

COMMON NUMBER	FORTRAN NAME	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
138	IRUNS1	- - -	
139	IRUNS2	- - -	Not used.
140	IRUNS3	- - -	
141	ICOND	0	Constant density selection switch (see HRHOZ)*.
142	NEWTPE	BRUNDM	Label new RUNDUM tape switch*.
143	ISTACK	BRUNDM	Stack RUNDUM files option*.
144	NRDDT	1	Multiples of frame time for RUNDUM data taking.
145	NLIST	0	No. of variables to be recorded by RUNDUM.
146	IZZSWP	- - -	
147	IONCE	- - -	Used by EAI 8400 only.
148	IBOPT	- - -	
149	IAUTO	USER	Commands auto hold when set.
150	ICRG0	- - -	
151	ICRG1	- - -	
152	ICRG3	- - -	
153	ICRG4	- - -	
154	ICRG7	- - -	
155	ICRG8	- - -	
156	ICRG9	- - -	Console registers used by EAI 8400.
157	ICRG10	- - -	
158	ICRG11	- - -	
159	ICRG13	- - -	
160	ICRG14	- - -	
161	ICRG15	- - -	
162	IVPA	1	Select visual system.
163	IFLEX	0	Enable motion flex computations*.
164	N2	2	Loop 2 multiple of loop 1 (see IDT1).
165	N3	4	Loop 3 multiple of loop 1 (see IDT1).
166	ITBAD	BQUIET	Control limit interference during trim.
167	IM	BQUIET	Control increment flag for BQUIET.

* Variable = 1 for condition indicated; otherwise zero.

Table 2 (Concluded)

COMMON NUMBER	FORTRAN NAME	ORIGIN AND/OR DEFAULT VALUE	DESCRIPTION
168	MODENB	BMOTION	Motion operator mode control.
169	ICENAB	BMOTION	Command to enable motion drive racks.
170	IDTFST	MOTHER	Fast I.C. frame time (msecs).
171	NHOLD	10	No. of hold cycle interations.
172	NADIN	SDAC	Enable ADC's*.
173	ISHORT	SDAC	Enable short side output*.
174	ILONG	SDAC	Enable long side output*.
175	IDRENB	DI	Motion drive racks enabled*.
176	INSDAC	DATA	Enable instrument DAC's*.
177	LOOPDR	DI	Drive rack loops are closed*.
178	ICDATC	INS10B	IC data outputs are still active*.
179	IREVAL	- - -	Not used.
180	NUSED	2	Ratio of ADC/DAC frame time to loop 1 frame time.
181	IDASTR	0	Starting channel number for ADC/DAC conversion.
182	ISTAB	0	Enable stability derivative evaluation*.
183	IVISFU	- - -	Note used.
184	IEULR	0	Interpret IC angular rates as Euler angle rates*.
185	IETURB	0	Turbulence is in local axes instead of body axes*.
186	IGRCMP	0	Turbulence continues after landing gear hits*.
187	ITOMTR	0	Zero $\dot{\alpha}$ and β in I.C.
188	IBTRAN	BTRANSFO and BLGA	Flag indicating updated axis transformation matrix.
189-199			Special purpose
200			Freeze fuselage dynamics

* Variable = 1 for condition indicated, otherwise zero.

Table 3

Common/RSRACOM/RCM (300)

COMMON	QUANTITY	FORTRAN	DEFINITION	UNITS	FROM
RCM (1)	V_{xg} $f(\tau)$	DVXG	BODY AXIS WIND VEL, X, DELAYED BY τ_T	FT/SEC	TAIL
RCM (2)	V_{yg} $f(\tau)$	DVYG	" " Y, " " "		"
RCM (3)	V_{zg} $f(\tau)$	DVZG	" " Z, " "		"
RCM (4)	FSE	FSJT	FUSELAGE STATION OF JET ENGINES	IN	DATA
RCM (5)	WLE	WLJT	WATER LINE " " "	"	"
RCM (6)	BLE	BLJT	BUTT LINE " "	"	"
RCM (7)	V_{XIE}	VXIE	PROPULSION ENGINE WASH, X	FT/SEC	TAIL
RCM (8)	V_{ZIE}	VZIE	" Z	"	"
RCM (9)	V_{YIW} $f(\tau)$	DVYIW	WING WAKE WASH V, DELAYED BY τ_T	"	"
RCM (10)	V_{ZIW} $f(\tau)$	DVZIW	" Z, "		
RCM (11)	θ_{OTR}	THØTR	TAIL ROTOR TOTAL COLLECTIVE INPUT	DEG.	CONTROL
RCM (12)	$E_{KTX}(D_{\omega o}\Omega_T R_T)$	EKXTERM	ROTOR DOWNWASH TERM AT TAIL	FT/SEC	TAIL
RCM (13)	$E_{KTZ}(D_{\omega o}\Omega_T R_T)$	EKZTERM		"	"
RCM (14)	FSCG	FSCG	FUSELAGE STATION OF CG	IN	DATA
RCM (15)	WLCG	WLCG	WATER LINE OF CG	"	"
RCM (16)	FSWT	FSWT	FUSELAGE STATION OF WING	"	"
RCM (17)	WLWT	WLWT	WATER LINE OF WING	"	"
RCM (18)	FSTR	FSTR	FUSELAGE STATION OF TAIL ROTOR	"	"
RCM (19)	WLTR	WLTR	WATER LINE OF TAIL ROTOR	"	"
RCM (20)	BLTR	BLTR	BUTT LINE OF TAIL ROTOR	"	"
RCM (21)	i_w	WINC	WING INCIDENCE	DEG.	CONTROL
RCM (22)	X_{wf}	XWF	BODY AXIS FORCES FROM WING, FUSELAGE, NAC	LB	AERO
RCM (23)	Y_{wf}	YWF	"	"	"
RCM (24)	Z_{wf}	ZWF	"	"	"
RCM (25)	L_{wf}	TLWF	MOMENTS	FT-LB	"
RCM (26)	M_{wf}	TMWF	"	"	"
RCM (27)	N_{wf}	TNWF	"	"	"
RCM (28)	VXGT	VXGT	BODY AXIS WIND + TURBULENCE, X	FT/SEC	AERO

Table 3 (Continued)

COMMON	QUANTITY	FORTRAN	DEFINITION	UNITS	FROM
RCM (29)	VYGT	VYGT	BODY AXIS WIND + TURBULENCE, Y	FT/SEC	AERO
RCM (30)	VZGT	VZGT	" Z	"	"
RCM (31)	α_{WF}	ALFWF	α OF WING - WITHOUT i_w	DEG	AERO
RCM (32)	β_{wf}	BETAWF	β OF WING	"	"
RCM (33)	i_e	XIJT	ENGINE SHAFT ANGLE	DEG	DATA
RCM (34)	D_{TOT}	TØTD	DRAG FORCE TOTAL OF WING, FUS, NAC	"	AERO
RCM (35)	Y_{TOT}	TØTY	SIDE FORCE "	"	"
RCM (36)	L_{MTOT}	TML	ROLL MOMENT "	FT-LB	"
RCM (37)	M_{MTOT}	TMM	PITCH "	"	"
RCM (38)	N_{MTOT}	TMN	YAW "	"	"
RCM (39)	i_{HTu}	UHTINC	UPPER HORIZONTAL TAIL INCIDENCE	DEG	BLOCK
RCM (40)	FSHTU	FSHTU	FUSELAGE STATION - UPPER HORIZONTAL TAIL	IN	BLOCK
RCM (41)	WLHTU	WLHTU	WATERLINE STATION - UPPER HORIZONTAL TAIL	IN	BLOCK
RCM (42)	KQVT	XKQVT	DYNAMIC PRESSURE LOSS FACTOR, VERT TAIL	ND	TAIL
RCM (43)	ΔC_{LF}	DCLFF3	LIFT INCREMENT DUE TO FLAP DEFLECTION	LB	AERO
RCM (44)	ψ_{wf}	PSIWF	WING-FUS. YAW ANGLE	DEG	AERO
RCM (45)	T_p+T_s	TJTSUM	TOTAL (PORT + STARBOARD) PROPULSION ENGINE THRUST	LB	ENGINE
RCM (46)	FSEI	FSJTI	FUSELAGE STATION OF PROPULSION ENGINE INLET	INS	DATA
RCM (47)	θ_{TR}	THETTR	TAIL ROTOR COLLECTIVE PITCH	LB	TROTOR
RCM (48)	δ_F	FLAP	FLAP ANGLE	LB	CONTR 7
RCM (49)	δ_a	AIL	AILERON	"	"
RCM (50)	δ_r	RUD	RUDDER	"	"
RCM (51)	δ_E	ELEV	ELEVATOR	"	"
RCM (52)	α_w	ALFWG	α AT WING + i_w	DEG	AERO
RCM (53)	X_{TR}	XTR	BODY AXIS FORCE FROM TAIL ROTOR, X	LB	TROTOR
RCM (54)	Y_{TR}	YTR	" " " " " " Y	LB	TROTOR
RCM (55)	Z_{TR}	ZTR	" " " " " " Z	LB	"
RCM (56)	L_{TR}	TRL	" " MOMENT " " " ROLL	FT-LB	"
RCM (57)	M_{TR}	TRM	" " " " " " PITCH	"	"

Table 3 (continued)

COMMON	QUANTITY	FORTRAN	DEFINITION	UNITS	FROM
RCM (58)	N_{TR}	TRN	BODY AXIS MOMENT FROM TAIL ROTOR, YAW	FT-LB	TROTOR
RCM (59)	FSHT	FSHT	FUSELAGE STATION OF LOWER HORIZONTAL TAIL	IN	DATA
RCM (60)	WLHT	WLHT	WATERLINE STATION OF LOWER HORIZONTAL TAIL	"	"
RCM (61)	FSVT	FSVT	FUSELAGE STATION OF VERTICAL TAIL	"	"
RCM (62)	WLVT	WLVT	WATERLINE " " " "	"	"
RCM (63)	FSDB	FSDB	FUSELAGE STATION OF DRAG BRAKE	"	"
RCM (64)	WLDB	WLDB	WATERLINE STATION OF DRAG BRAKE	"	"
RCM (65)	X_T	XT	BODY AXIS FORCE FROM EMPENNAGE, X	LB	TAIL
RCM (66)	Y_T	YT	" " " " " , Y	LB	TAIL
RCM (67)	Z_T	ZT	" " " " " , Z	LB	"
RCM (68)	L_T	TLT	" " MOMENT " " , ROLL	FT-LB	"
RCM (69)	M_T	TMT	" " " " " , PITCH	"	"
RCM (70)	N_T	TNT	" " " " " , YAW	"	"
RCM (71)	D_{WTR}	DWTR	DOWNWASH FROM TAIL ROTOR	N.D.	TROTOR
RCM (72)	Ω_{TR}	MEGTR	TAIL ROTOR ANGULAR VELOCITY	RAD/SEC	TROTOR
RCM (73)	R_{TR}	RTR	TAIL ROTOR RADIUS	FT	DATA
RCM (74)	i_{HT}	XIHT	LOWER HORIZONTAL TAIL INCIDENCE	DEG	TAIL
RCM (75)	ALFWFR	ALFWFR	ANGLE OF ATTACK-BODY AXES	RAD	AERO
RCM (76)	q_{WF}	QWF	DYNAMIC PRESSURE AT WING-FUSELAGE	LB/FT^2	AERO
RCM (77)	δ_{DB}	DRAG	DRAG BRAKE ANGLE	DEG	CONTROL
RCM (78)	X_E	XJT	BODY AXIS FORCE FROM PROPULSION ENGINES, X	LB	ENGINE
RCM (79)	Y_E	YJT	" " " " " " , Y	"	"
RCM (80)	Z_E	ZJT	" " " " " " , Z	"	"
RCM (81)	L_E	TLJT	BODY AXIS MOMENT FROM PROPULSION ENGINES, ROLL	FT-LB	ENGINE
RCM (82)	M_E	TMJT	" " " " " " , PITCH	"	"
RCM (83)	N_E	TNJT	" " " " " " , YAW	"	"
RCM (84)	V_{XWF}	VXWF	WING-FUSELAGE VELOCITY COMPONENT, X	FT/SEC	AERO
RCM (85)	V_{YWF}	VYWF	" " " " " , Y	"	"
RCM (86)	V_{ZWF}	VZWF	" " " " " , Z	"	"

Table 3 (Continued)

COMMON	QUANTITY	FORTRAN	DEFINITION	UNITS	FROM
RCM (87)	XATRM	XATRM	TRIM VALUE OF LATERAL STICK	%	TRIM OR DATA
RCM (88)	XBTRM	XBTRM	" " " LONGITUDINAL STICK	"	"
RCM (89)	XCTRM	XCTRM	" " " COLLECTIVE	"	"
RCM (90)	XPTRM	XPTRM	" " " PEDALS	"	"
RCM (91)	CDELA	CDELA	CPU GAIN TO AILERONS	DEG/DEG	CONTR 7
RCM (92)	CDELE	CDELE	" " " ELEVATORS	"	"
RCM (93)	CTTR	CTTR	" " " TAIL ROTOR	"	"
RCM (94)	CA1S	CA1S	" " " LATERAL ROTOR CONTROL	"	CONTR 8
RCM (95)	CB1S	CB1S	" " " LONGITUDINAL ROTOR CONTROL	"	"
RCM (96)	(PRPM) LIFT	RPMJETP	ACTUAL JET ENGINE RPM (PORT ENGINE)	%	ENGINE
RCM (97)	TKQB	TKB	ROTOR LONGITUDINAL SAS LAGGED PITCH RATE TIME CONSTANT	SEC	DATA
RCM (98)	RKQB	RKB	" " " PITCH RATE GAIN	DEG/DEG/SEC	DATA
RCM (99)	LRKQB	BLRK	" " " LAGGED PITCH RATE GAIN	"	DATA
RCM (100)	TKQE	TKE	ELEVATOR SAS LAGGED PITCH RATE TIME CONSTANT	SEC	"
RCM (101)	RKQE	RKE	ELEVATOR SAS PITCH RATE GAIN	DEG/DEG/SEC	DATA
RCM (102)	LRKQE	ELRK	ELEVATOR SAS LAGGED PITCH RATE GAIN	"	"
RCM (103)	TKPS	TKA1	ROTOR LATERAL SAS LAGGED ROLL RATE TIME CONSTANT	SEC	"
RCM (104)	RKPS	RKA1	" " " ROLL RATE GAIN	DEG/DEG/SEC	"
RCM (105)	LRKPS	A1LRK	" " " LAGGED ROLL RATE GAIN	"	"
RCM (106)	TKPL	TKA	AILERON SAS LAGGED ROLL RATE TIME CONSTANT	SEC	"
RCM (107)	RKPL	RKA	" " ROLL RATE GAIN	DEG/DEG/SEC	"
RCM (108)	LRKPL	ALRK	" " LAGGED ROLL RATE GAIN	"	"
RCM (109)	TKRT	TK5T	TAIL ROTOR SAS LAGGED YAW RATE TIME CONSTANT	SEC	"
RCM (110)	RKRT	RK8T	" " " YAW RATE GAIN	DEG/DEG/SEC	"
RCM (111)	LRKRT	TLRK5	" " " LAGGED YAW RATE GAIN	"	"
RCM (112)	TKRR	TK5R	RUDDER SAS LAGGED YAW RATE TIME CONSTANT	SEC	"
RCM (113)	RKRR	RK8R	" " YAW RATE GAIN	DEG/DEG/SEC	"
RCM (114)	LRKRR	RLRK5	" " LAGGED YAW RATE GAIN	"	"
RCM (115)	RKRPS	RKYA1	ROTOR LATERAL SAS YAW RATE GAIN	"	"

Table 3 (Continued)

COMMON	QUANTITY	FORTRAN	DEFINITION	UNITS	FROM
RCM (116)	RKRPL	RKYA	AILERON SAS YAW RATE GAIN	DEG/DEG/SEC	DATA
RCM (117)	RKPRT	RKR7T	TAIL ROTOR SAS ROLL RATE GAIN	"	"
RCM (118)	RKPRR	RKR7R	RUDDER SAS ROLL RATE GAIN	"	"
RCM (119)	ω_{OB}	WØB	ROTOR LONGITUDINAL SAS WASH-OUT CONSTANT	HZ	"
RCM (120)	ω_{OE}	WØE	ELEVATOR SAS WASH-OUT CONSTANT	HZ	"
RCM (121)	SIN (α_{WF})	SALFW	SINE OF WING-FUSELAGE ANGLE OF ATTACK	N.D.	AERO
RCM (122)	COS (α_{WF})	CALFW	COSINE OF " " " " "	N.D.	"
RCM (123)	X_P	DPEDAL	PEDAL POSITION	%	CONTR7
RCM (124)	α_{PE}LEFT	RPMP	PILOT COMMANDED RPM (PORT ENGINE)	%	CONTR7
RCM (125)	XRPMJT LEFT	XRPMJTP	PILOT RPM STICK POSITION (PORT ENGINE)	%	PILOT
RCM (126)	δ_{PE} RIGHT	RPMS	PILOT COMMANDED RPM (STARBOARD ENGINE)	%	CONTR7
RCM (127)	XRPMJT RIGHT	XRPMJTS	PILOT RPM STICK POSITION (STARBOARD)	%	PILOT
RCM (128)	(PRPM) RIGHT	RPMJETS	ACTUAL JET ENGINE RPM (STARBOARD)	%	ENGINE
RCM (129)	$(\frac{D}{q})$TAIL OFF	CDF3	WING-FUSELAGE DRAG DUE TO ANGLE OF ATTACK	LB	MAP111
RCM (130)	TAIL OFF	CLF3	" " LIFT " " " " "	LB	MAP111
RCM (131)	WEIGHT	WEIGHT	TOTAL WEIGHT OF A/C (INCLUDING BLADES)	LB.	BLOCK
RCM (132)	T_P	TJTP	NET THRUST-PORT ENGINE	LB.	ENG.
RCM (133)	TS	TJTS	" " -STARBOARD ENGINE	LB.	ENG.
RCM (134)	X_C	COLSTK	COLLECTIVE STICK POSITION	%	PILOT
RCM (135)	KCPULG	GKCPULG	LONGITUDINAL CPU LEVER GEARING	N.D.	DATA
RCM (136)	KCPULT	GKCPULT	LATERAL " " "	N.D.	DATA
RCM (137)	A_{1S}	A1S	TOTAL LATERAL CYCLIC AT THE ROTOR HEAD	DEG	CONTR8
RCM (138)	B_{1S}	B1S	" LONGITUDINAL CYCLIC AT THE ROTOR HEAD	"	"
RCM (139)	θ_{CUFF}	THETAO	COLLECTIVE PITCH AT THE ROTOR HEAD	"	" 7 & 8
RCM (140)	THOL	THOL	LOWER LIMIT ON COLLECTIVE PITCH	"	DATA
RCM (141)	THOU	THOU	UPPER LIMIT ON COLLECTIVE PITCH	"	"
RCM (142)	Σ BCPULG Δ T	CPLGTRM	LONGITUDINAL CPU TRIM (FROM BEEPER)	%	CONTR8
RCM (143)	Σ BCPULT Δ T	CPLTTRM	LATERAL CPU TRIM (FROM BEEPER)	%	"
RCM (144)	CPUDIR	CPUDIR	DIRECTIONAL CPU POSITION	%	CONTR7

Table 3 (Continued)

COMMON	QUANTITY	FORTRAN	DEFINITION	UNITS	FROM
RCM (145)	ELEV1	ELVTRM	ELEVATOR SERIES TRIM	DEG	CONTR7
RCM (146)	AIL1	AILTRM	AILERON " "	"	"
RCM (147)	L_{WT}	TOTLWT	TOTAL LIFT, WIND TUNNEL AXES	LB	FORCE
RCM (148)	D_{WT}	TOTDWT	" DRAG, " " "	"	"
RCM (149)	KASAIL	XKASAIL	AILERON ASSYMETRIC GEARING RATIO GAIN	N.D.	DATA
RCM (150)	XAILG	XAILG	" " " " GAIN	"	"
RCM (151)	f(A)(LONG.)	GGRADLO	LONGITUDINAL STICK GRADIENT	LB/IN	CONTR7
RCM (152)	f(B) (LONG.)	DDAMPLO	" " DAMPING	LB/IN/SEC	"
RCM (153)	f(C) (LONG.)	ACRTLO	" " FORCE DEPENDENT ON A/C SPEED	LB/DEG/SEC	"
RCM (154)	f(A) (LAT.)	GGRADLA	LATERAL STICK GRADIENT	LB/IN	"
RCM (155)	f(B) (LAT.)	DDAMPLA	" " DAMPING	LB/IN/SEC	"
RCM (156)	f(C) (LAT.)	ACRTLA	" " FORCE DEPENDENT ON A/C SPEED	LB/DEG/SEC	"
RCM (157)	f(A) (DIR.)	GRADIN	PEDAL GRADIENT	LB/IN	"
RCM (158)	f(B) (DIR.)	DAMPDIN	PEDAL DAMPING	LB/IN/SEC	"
RCM (159)	K_{EG}	GKEG	ELEVATOR-LOWER HORIZONTAL TAIL GAIN	DEG/DEG	"
RCM (160)	CTW	CTW	WING-LOWER HORIZONTAL TAIL NON-LINEAR CONSTANT	DEG	"
RCM (161)	KTW1	XKTW1	WING-LOWER HORIZONTAL TAIL NON-LINEAR GAIN	N.D.	DATA CONTROL
RCM (162)	KTW2	XKTW2	" " " " " "	DEG^{-1}	DATA
RCM (163)	KTW5	XKTW5	" " " " " "	DEG^{-4}	DATA
RCM (164)	KTLIN1	XKTLIN1	LOWER HORIZONTAL TAIL LINEARIZATION GEARING COEFFICIENT	N.D.	DATA CONTROL
RCM (165)	KTLIN5	XKTLIN5	" " " " " "	DEG^{-4}	DATA CONTROL
RCM (166)	CTFLAP	CTFLAP	FLAP GEARING COEFFICIENT	DEG	DATA
RCM (167)	KTFLAP	XKTFLAP	" " "	N.D.	DATA
RCM (168)	S_W	SW	WING AREA	FT^2	BLOCK
RCM (169)	CPULON	CPULON	LONG CPU CONTROL LEVER		ROTCON
RCM (170)	CPULAT	CPULAT	LATERAL CPU CONTROL LEVER		ROTCON
RCM (171)	X_A	XA	LATERAL STICK POSITION	%	ROTCON
RCM (172)	X_B	XB	LONG STICK POSITION	%	ROTCON
RCM (173)	δ_{A2}	SASA	LATERAL SAS INPUT TO AILERONS	DEG	ROTCON

Table 3 (Continued)

COMMON	QUANTITY	FORTRAN	DEFINITION	UNITS	FROM
RCM (174)		SASE	LONG SAS INPUT TO ELEVATORS	DEG	ROTCON
RCM (175)		XIHTPU	LOWER HORIZONTAL TAIL INCIDENCE (UPPER LIMIT)	DEG	DATA CONTROL
RCM (176)		XIHTPL	" " " " (LOWER LIMIT)	DEG	DATA CONTROL
RCM (177)		AILU	AILERON DEFLECTION ANGLES (UPPER LIMIT)	DEG	DATA CONTROL
RCM (178)		AILL	" " " (LOWER LIMIT)	DEG	DATA CONTROL
RCM (179)	XRPMTRM	XRPMTRM	ENGINE RPM TRIM VALUE	%	TRIM & SETUP
RCM (180)	K_{CPULG}	XCPULG	LONGITUDINAL CPU - PILOT INPUT	%	CONTROL
RCM (181)		XCPULT	LATERAL CPU - PILOT INPUT	%	CONTROL
RCM (182)		XCPUDR	LONGITUDINAL CPU - PILOT INPUT	"	"
RCM (183)		XDRAG	PILOT CONTROL - DRAG BRAKE	"	"
RCM (184)		XFLAP	PILOT FLAP CONTROL	"	"
RCM (185)		XWING	PILOT WING INCIDENCE CONTROL	"	"
RCM (186)		CLMF3	ROLLING MOMENT COEFFICIENT		MAP111
RCM (187)		DVXB			
RCM (188)		DVYB			
RCM (189)		DVZB			
RCM (190)		FAO	β_0 (FLAPPING MULTIBLADE COEFFICIENTS)	RAD	ROTOR
RCM (191)		FA1C	β_{1C}	"	"
RCM (192)		FA1S	β_{1S}	"	"
RCM (193)		FAOD	$\dot{\beta}_0$	RAD/SEC	"
RCM (194)		FA1CD	$\dot{\beta}_{1C}$	"	"
RCM (195)		FA1SD	$\dot{\beta}_{1S}$	"	"
RCM (196)		FAODD	$\ddot{\beta}_0$	RAD/SEC/SEC	"
RCM (197)		FA1CDD	$\ddot{\beta}_{1C}$	"	"
RCM (198)		FA1SDD	$\ddot{\beta}_{1S}$	"	"
RCM (199)		CPS(1)	FREQUENCIES OF SINE WAVE INPUTS (IF IWAVE =1 & IRS=1)	"	DATA UTIL
RCM (200)		CPS(2)	" " " " " "	"	"

Table 3 (Continued)

COMMON	QUANTITY	FORTRAN	DEFINITION	UNITS	FROM
RCM (201)		XDC(1)	DYNAMIC CHECK INPUT TO LATERAL STICK		
RCM (202)		XDC(2)	" " " " LONGITUDINAL STICK		
RCM (203)		XDC(3)	" " " " COLLECTIVE STICK		
RCM (204)		XDC(4)	" " " " DIRECTIONAL CONTROL		
RCM (205)		EPXA	EP LATERAL STICK POSITION		
RCM (206)		EPXB	" LONGITUDINAL STICK POSITION		
RCM (207)		EPXC	" COLLECTIVE STICK POSITION		
RCM (208)		EPXP	" YAW STICK POSITION		
RCM (209)		SCALEF(1)			BDCKIC UTIL
RCM (210)		" (2)			"
RCM (211)		" (3)			"
RCM (212)		" (4)			"
RCM (213)		" (5)			"
RCM (214)		" (6)			"
RCM (215)		" (7)			"
RCM (216)		" (8)			"
RCM (217)		" (9)			"
RCM (218)		" (10)			"
RCM (219)		PHASE (1)			"
RCM (220)		" (2)			"
RCM (221)		" (3)			"
RCM (222)		" (4)			"
RCM (223)		" (5)			"
RCM (224)		" (6)			"
RCM (225)		" (7)			"
RCM (226)		" (8)			"
RCM (227)		" (9)			"
RCM (228)		" (10)			"

Table 3 (Continued)

COMMON	QUANTITY	FORTRAN	DEFINITION	UNITS	FROM
RCM (229)		BR1	BLADE FLAPPING ANGLES	RAD	ROTOR
RCM (230		BR2	"	"	"
RCM (231)		BR3	"	"	"
RCM (232)		BR4	"	"	"
RCM (233)		BR5	"	"	"
RCM (234)		PSI1	BLADE AZIMUTH ANGLES	DEG	"
RCM (235)		PSI2	"	"	"
RCM (236)		PSI3	"	"	"
RCM (237)		PSI4	"	"	"
RCM (238)		PSI5	"	"	"
RCM (239)		AMP WAVE(1)	AMPLITUDE OF SINE WAVE DISTURBANCES	"	"
RCM (240)		" " (2)	" IF IWAVE=1 (IRS(38))	"	"
RCM (241)		" " (3)	"	"	"
RCM (242)		SIGFO	* $\dot{\beta}_o$ FLAPPING FOURIER COEFFICIENTS LESS AXIS TRANSFORM PARTS	RAD/SEC^2	"
RCM (243)		SIGF1C	* β_{1C} "	"	"
RCM (244)		SIGF1S	* β_{1S} "	"	"
RCM (245)		FA2C	β_{2C} FLAPPING FOURIER COEFFICIENTS	RAD	"
RCM (246)		FA2S	β_{2S} "	"	"
RCM (247)		FL0	ξ_o LAGGING FOURIER COEFFICIENTS	"	"
RCM (248)		FL1C	ξ_{1C} "	"	"
RCM (249)		FL1S	ξ_{1S} "	"	"
RCM (250)		FL0D	$\dot{\xi}_o$ "	RAD/SEC	"
RCM (251)		FL1CD	$\dot{\xi}_{1C}$ "	"	"
RCM (252)		FL1SD	$\dot{\xi}_{1S}$ "	"	"
RCM (253)		SIGL0	* ξ_o LAGGING FOURIER COEFFICIENTS LESS AXIS TRANSFORM AND LAG DAMPER PARTS	RAD/SEC^2	"
RCM (254)		SIGL1C	* ξ_{1C} "	"	"
RCM (255)		SIGL1S	* ξ_{1S} "	"	"
RCM (256)		FL2C	ξ_{2C} LAGGING FOURIER COEFFICIENTS	RAD	"

Table 3 (Continued)

COMMON	QUANTITY	FORTRAN	DEFINITION	UNITS	FROM
RCM (257)		FL2S	ξ_{2S} LAGGING FOURIER COEFFICIENTS	RAD	"
RCM (258)		BETO			"
RCM (259)		BET1C			"
RCM (260)		BET1S			"
RCM (261)		BET2C			"
RCM (262)		BET2S			
RCM (263)		XIBMR			
RCM (264)		FA2CD	$\dot{\beta}_{2C}$ FLAPPING FOURIER COEFFICIENTS	RAD/SEC	ROTOR
RCM (265)		FA2SD	$\dot{\beta}_{2S}$ "	"	"
RCM (266)		SIGF2C	* $\ddot{\beta}_{2C}$ FLAPPING FOURIER COEFFICIENTS LESS AXIS TRANSFORM PARTS	RAD/SEC^2	"
RCM (267)		SIGF2S	* $\ddot{\beta}_{2S}$ " " " " " " "	"	"
RCM (268)		FL2CD	$\dot{\xi}_{2C}$ LAGGING FOURIER COEFFICIENTS	RAD/SEC	"
RCM (269)		FL2SD	$\dot{\xi}_{2S}$ " " "	"	"
RCM (270)		SIGL2C	* $\ddot{\xi}_{2C}$ LAGGING FOURIER COEFFICIENTS LESS AXIS TRANSFORM PARTS	RAD/SEC^2	"
RCM (271)		SIGL2S	* $\ddot{\xi}_{2S}$ " " AND LAG DAMPER TORQUE PART	"	"
RCM (272)		QLDO	LAG DAMPER TORQUES IN MULTI-BLADE COORDINATES	FT LB	ROTOR
RCM (273)		QLD1C	"	"	"
RCM (274)		QLD1S	"	"	"
RCM (275)		QLD2C	"	"	"
RCM (276)		QLD2S	"	"	"
RCM (277)		ZODD	$\Delta\xi_0$ LAGGING FOURIER COEFFICIENTS LESS AXIS TRANSFORM PARTS	RAD/SEC^2	"
RCM (278)		Z1CDD	$\Delta\xi_{1C}$ "	"	"
RCM (279)		Z1SDD	$\Delta\xi_{1S}$ "	"	"
RCM (280)		Z2CDD	$\Delta\xi_{2C}$ "	"	"
RCM (281)		Z2SDD	$\Delta\xi_{2S}$ "	"	"
RCM (282)					
RCM (283)					
RCM (284)					
RCM (285)					

Table 3 (Concluded)

COMMON	QUANTITY	FORTRAN	DEFINITION	UNITS	FROM
RCM (286)					
RCM (287)					
RCM (288)					
RCM (289)		TRAMP			UTIL
RCM (290)		TDS	TIME INPUT IS TO BE APPLIED	SEC	"
RCM (291)					
RCM (292)		H	X FORCE ON ROTOR	LB	ROTOR
RCM (293)		J	Y " " "	"	"
RCM (294)		T	Z " " "	"	"
RCM (295)		L_H	X TORQUE ON ROTOR	FT LB	"
RCM (296)		MH	Y " " "	"	"
RCM (297)		QH	Z " " "	"	"
RCM (298)		QLD	TOTAL TORQUE DUE TO LAG DAMPERS	"	"
RCM (299)		XA1SAC	ATTITUDE CONTROLLER GAINS		ROTOR CONTROL
RCM (300)		XB1SAC	"		"

Table 4
Common/ROTOUT/RO (22)

COMMON	QUANTITY	FORTRAN	DEFINITION	UNITS	FROM
RO (1)	D_{WO}	DOWNW	UNIFORM COMPONENT OF ROTOR DOWNWASH	ND	ROTOR
RO (2)	Ω_T	OMEGAM	ROTOR ANGULAR VELOCITY (TRIM)	RAD/SEC	"
RO (3)	R_T	RMR	ROTOR RADIUS	FT	"
RO (4)	Ω	OMGMR	ACTUAL ROTOR ANGULAR VELOCITY	RAD/SEC	"
RO (5)	X_{MR}	XMR	ROTOR BODY AXIS FORCE, X	LBS.	"
RO (6)	Y_{MR}	YMR	" " " ", Y	"	"
RO (7)	Z_{MR}	ZMR	" " " ", Z	"	"
RO (8)	L_{MR}	RML	ROTOR BODY AXIS MOMENT, L	FT-LBS	"
RO (9)	M_{MR}	RMM	" " " ", M	"	"
RO (10)	N_{MR}	RMN	" " " " N	"	"
RO (11)	χ	CHI	ROTOR WAKE SKEW ANGLE	DEG.	"
RO (12)	λ	XLAMDA	ROTOR INFLOW	N.D.	"
RO (13)	NBS	NBS	NUMBER OF BLADES SIMULATED	N.D.	"
RO (14)	NSS	NSS	NUMBER OF SEGMENTS SIMULATED	N.D.	"
RO (15)	β	BR	BLADE FLAPPING ANGLE	RAD	"
RO (16)	δ	XLAG	BLADE LAGGING ANGLE	"	"
RO (17)	XB1SEQ	XB1SEQ	LONGITUDINGAL STICK EQUIV. POSITION DUE TO B1S SERIES TRIM	%	CONTR8
RO (18)	XA1SEQ	XA1SEQ	LATERAL STICK EQUIV. POSITION DUE TO A1S SERIES TRIM	%	"
RO (19)	Ω/Ω_T	OMGRAT	RATIO OF ACTUAL TO TRIMMED ROTOR SPEED	N.D.	ROTOR
RO (20)		QBARMR	FILTERED ROTOR MOMENT - YAW	FT-LB	"
RO (21)		BMR			ROTOR
RO (22)		WTBLAD			ROTOR

Table 5

Common/ACOUT/ACO (40)

COMMON	QUANTITY	FORTRAN	DEFINITION	UNITS	FROM
ACO (1)	V_{XB}	VXB	BODY AXIS VEL. OF CG WITHOUT WIND, X	FT/SEC	AERO
ACO (2)	V_{YB}	VYB	" " " " " " ", Y	"	"
ACO (3)	V_{ZB}	VZB	" " " " " " ", Z	"	"
ACO (4)	$\dot{V}_{XB}$	VXBDOT	" " ACCELERATION " ", X	FT/SEC^2	"
ACO (5)	$\dot{V}_{YB}$	VYBDOT	" " " " ", Y	"	"
ACO (6)	$\dot{V}_{ZB}$	VZBDOT	" " " " ", Z	"	"
ACO (7)	V_{XG}	VXG	BODY AXIS VEL OF WIND, X	FT/SEC	"
ACO (8)	V_{YG}	VYG	" " " " ", Y	"	"
ACO (9)	V_{ZG}	VZG	" " " " ", Z	"	"
ACO (10)		AC1			
ACO (11)	CPULGFX	CPULGFX	LONG. CPU DRIVE FOR CAB INSTRUMENT	FT/SEC	CONTR7
ACO (12)	CPULTFX	CPULTFX	LAT. " " " " "	"	CONTR7
ACO (13)	δ_{RE}	DRE	ROTOR SPEED CONTROL	N.D.	CONTR7
ACO (14)	L_{TOT}	TOTL	LIFT IN WING AXIS OF WING-FUS-NAC	LB	AERO
ACO (15)	GRADLO	GRADLO	TOTAL LONGITUDINAL STICK GRADIENT	LB/IN	CONTR7
ACO (16)	GRADLA	GRADLA	" LATERAL " "	"	"
ACO (17)	GRADI	GRADI	" PEDAL GRADIENT	"	"
ACO (18)	DAMPLO	DAMPLO	" LONGITUDINAL STICK DAMPING	LB/IN/SEC	"
ACO (19)	DAMPLA	DAMPLA	" LATERAL " "	"	"
ACO (20)	DAMPDI	DAMPDI	" PEDAL DAMPING	"	"
ACO (21)	BIASLO	BIASLO	LONGITUDINAL STICK BIAS	LB	CONTR7
ACO (22)	BIASLA	BIASLA	LATERAL STICK BIAS	LB	"
ACO (23)	BIASDR	BIASDR	PEDAL BIAS	"	"
ACO (24)	BOLO	BOLO	LONGITUDINAL STICK BREAK-OUT	"	"
ACO (25)	BOLA	BOLA	LATERAL STICK BREAK-OUT	"	"
ACO (26)	BODI	BODI	PEDAL BREAK-OUT	"	"
ACO (27)	HSTLO	HSTLO	LONGITUDINAL STICK HYSTERESIS	"	"
ACO (28)	HSTLA	HSTLA	LATERAL STICK HYSTERESIS	"	"

Table 5 (Continued)

COMMON	QUANTITY	FORTRAN	DEFINITION	UNITS	FROM
ACO (29)	HSTDI	HSTDI	PEDAL HYSTERESIS	LB	CONTR7
ACO (30)	TLOIN	TLOIN	LONGITUDINAL STICK PARALLEL TRIM POSITION - INCHES	IN	CONTR7
ACO (31)	TLAIN	TLAIN	LATERAL STICK PARALLEL TRIM POSITION - INCHES	IN	CONTR7
ACO (32)	TDIIN	TDIIN	PEDAL " " " "	"	"
ACO (33)	STOPLO	STOPLO	COMPUTED STOP - LONGITUDINAL STICK	IN	"
ACO (34)	STOPLA	STOPLA	COMPUTED STOP - LATERAL STICK	"	"
ACO (35)	STOPDR	STOPDR	" " - PEDALS	"	"
ACO (36)		ALFDIF	DIFFERENCE BETWEEN ACTUAL α AND TRIMMED α	DEG	AERO
ACO (37)		BETDIF	" " " β " " β	"	"
ACO (38)					
ACO (39)					
ACO (40)					

Table 6
Common/IRSRA/IRS (50)

COMMON	QUANTITY	FORTRAN	DEFINITION	UNITS	FROM
IRS (1)	ICONFIG	ICONFIG	CONFIGURATION SWITCH	N.D.	DATA OR ENGINEER
IRS (2)	LAGLIM	LAGLIM	LIMIT ROTOR LAG TO $\pm$ 15^{o} FOR 60^{o} PASSES	"	TRIM
IRS (3)	NOROT	NOROT	NO MAIN ROTOR	"	ROTOR
IRS (4)	NOTROT	NOTROT	NO TAIL ROTOR	"	TAIL
IRS (5)	ITRLIM	ITRLIM	TRIM VALUE OF A CONTROL HAS REACHED A LIMIT	"	TRIM
IRS (6)	NCYC1	NCYC1	Σ7 CYCLE INDICATOR	"	UTIL7
IRS (7)	NCYC2	NCYC2	" " "	"	"
IRS (8)	NCYC3	NCYC3	" " "	"	"
IRS (9)	NCYC4	NCYC4	" " "	"	"
IRS (10)	A	IRLSWA	FIX LONG. AND LAT. CPU's AT 33% FOLLOWING ROTOR RELEASE	"	"
IRS (11)	B	IRLSWB	FIX TAIL ROTOR AND RUDDER MIXING GAINS TO A FOLLOWING ROTOR RELEASE	"	DATA OR ENGINEER
IRS (12)	NOROTIC	NOROTIC	FIXED WING CONFIGURATION - NO ROTOR (FROM I.C.)	"	"
IRS (13)	ISEHO	ISEHO	ELEVATOR SAS HARDOVER	"	"
IRS (14)	ISAHO	ISAHO	AILERON " "	"	"
IRS (15)	ISRHO	ISRHO	RUDDER " "	"	"
IRS (16)	ISTRHO	ISTRHO	TAIL ROTOR SAS HARDCOVER	"	"
IRS (17)	ISBHO	ISBHO	LONGITUDINAL CYCLIC SAS HARDOVER	"	"
IRS (18)	ISA1HO	ISA1HO	LATERAL CYCLIC SAS HARDOVER	"	"
IRS (19)	ITRHO	ITRHO	TAIL ROTOR HARDOVER	"	"
IRS (20)	IFLPHO	IFLPHO	FLAP HARDOVER	"	"
IRS (21)	IWNGJM	IWNGJM	WING INCIDENCE JAM	N.D.	DATA OR ENGINEER
IRS (22)	IWNGHO	IWNGHO	" " "	"	"
IRS (23)	IDRGF	IDRGF	DRAG BRAKE FAILURE ($\pm$ 15^{o} FROM PRESENT POSITION)	"	"
IRS (24)	IFLO	IFLO	LONGITUDINAL STICK FORCE FEEL SYSTEM FAILURE	"	"
IRS (25)	IFLA	IFLA	LATERAL STICK FORCE FEEL SYSTEM FAILURE	"	"
IRS (26)	IFDR	IFDR	PEDAL " " "	"	"
IRS (27)	IJTPFL	IJTPFL	PORT ENGINE FAILURE	"	"
IRS (28)	IJTSFL	IJTSFL	STARBOARD ENGINE FAILURE	"	"

Table 6 (Continued)

COMMON	QUANTITY	FORTRAN	DEFINITION	UNITS	FROM
IRS (29)	NOTROTIC	NOTROTIC	NO TAIL ROTOR (FROM I.C.)	N.D.	DATA OR ENGINEER
IRS (30)	NOTROTSW	NOTFROTSW	TAIL ROTOR SEVERANCE FAILURE SWITCH	"	"
IRS (31)		ICFLAG	FLAG TO DETERMINE IC VALUES FOR DIFFERENT CONFIG.		ICSET
IRS (32)		ISAVE	STORE EVERY ISAVE STEP		DATA UTIL
IRS (33)		ICOUNT	CURRENT INTEGRATION STEP		DATA
IRS (34)		ICNTL1			"
IRS (35)		ICNTL2			"
IRS (36)		ICNTL3			"
IRS (37)		IRAMP	=1 FOR A RAMP INPUT		"
IRS (38)		IWAVE	=1 FOR A SINE WAVE INPUT		"
IRS (39)		ICDYNCH			"
IRS (40)		ICOMMON	COMMON BLOCK INDICATOR: 1-A( )		BDCHKIC DATA
			2-RCM( ) , SEE IRS (41)		
			3-ACO( )		
IRS (41)		ICELL	VARIABLE INDICATED BY IRS (40) TO BE PERTURBED BY SINE		BDCHKIC DATA
IRS (42)		IRPF	ROTOR POWER FAILURE SWITCH. 0 = CONSTANT SPEED		DATA ROTOR
			1 =		
			2 = CONSTANT ENGINE TORQUE		
			3 = NONLINEAR ENGINE		
IRS (43)					
IRS (44)					
IRS (45)					
IRS (46)					
IRS (47)					
IRS (48)					
IRS (49)					
IRS (50)		ILIN	= 1, USE PERTURBATION ROTOR AND FUSELAGE AERO EQUATIONS		FASTP

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16. Abstract

A study was conducted to establish a coupled rotor/propulsion analysis that would be applicable to a wide range of rotorcraft systems. The effort included the following tasks: (1) development of a model structure suitable for simulating a wide range of rotorcraft configurations; (2) defined a methodology for parameterizing the model struture to represent a particular rotorcraft; (3) constructing a nonlinear coupled rotor/propulsion model as a test case to use in analyzing coupled system dynamics; and (4) an attempt to develop a mostly linear coupled model derived from the complete nonlinear simulations. Volume I contains the details of the modelling process and its implementation approach. Volume II contains documentation of the computer models developed under this investigation.

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